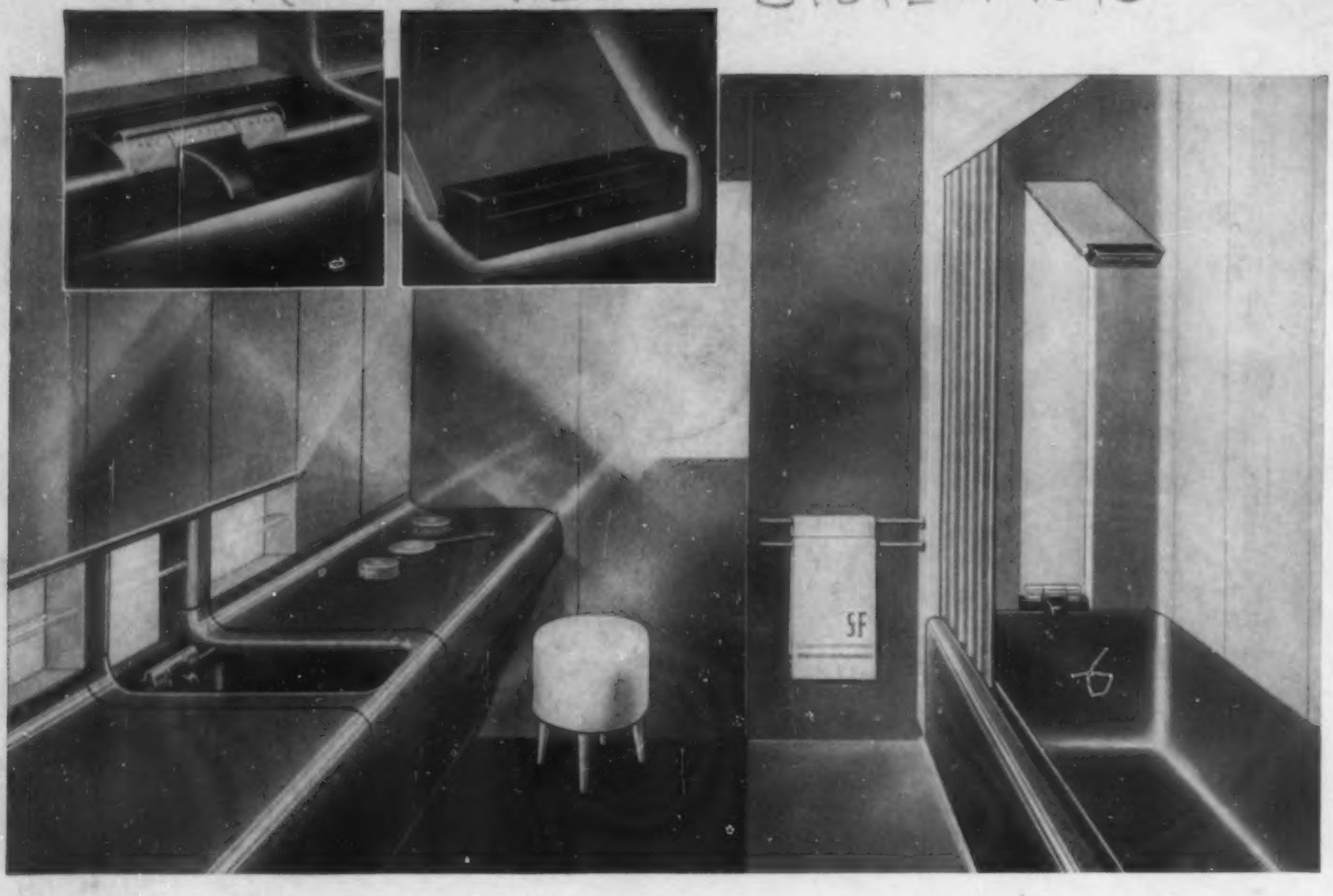
MODERN PLASTICS

mp

SEPTEMBER 1942

✓R v.20' S1942-F1943



Not since Nero...

CARL SUNDBERG
Industrial Designer, of the firm of Sundberg & Ferar

LIKE THE MAGNIFICENT BATHS erected by the Roman emperors . . . the mere term, "American plumbing," has become a legend, evoking admiration and awe in all languages. Yet impressive as our creature comforts may be today they are soon to be superseded!

Superseded and forgotten because of the progress afforded by relatively new structural materials . . . Durez phenolic plastics and resins. These have directly inspired the future bathroom visualized for you here by Sundberg & Ferar. As Mr. Sundberg says . . .

"Structurally, Durez phenolic molding compounds are ideal. To begin with, they are unaffected by heat, moisture or the mild alkalis and acids common to bathroom essentials—soaps, lotions, disinfectants, etc. Aesthetically, plastics provide a lustrous, satin-smooth finish. As for costs, they permit economical mass-production of whole units since complicated moldings can often be achieved in one simple operation.

"Thus we arrived at the combination of wash basin with really ample laundry and supply cabinets on the left. At right, you have a plastic shower which folds into the wall when not in use. In addition, this shower is adjustable in height, eliminating the need for shower caps. In detail, look what happens to the familiar faucet and shower-head when re-housed in gleaming Durez. Even the walls may take on a new face . . . utilizing Durez resin-bonded or impregnated materials, molded under low pressure and prefabricated into standard units."

Here is another field in which plastics can help America's *post*-war planning to prosper. But first . . . the victory! Have you a *war*-production problem that may find a fresh solution in plastics' versatility? Durez engineers and chemists will be glad to serve you. Further, if you wish to learn more about phenolic plastics and resins . . . a request on your business letterhead will bring *Durez Plastics News* to your desk.

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

DUREZ...plastics that fit the job

DUREZ PLASTICS & CHEMICALS, INC. DUREZ 1129 WALCK ROAD, N. TONAWANDA, N. Y.

Tech

In two sections—Section 1

modern plastics

INCLUDING

Plastics ENGINEERING

CHARLES A. BRESKIN, Publisher
RAYMOND R. DICKEY, Editor
DR. GORDON M. KLINE, Technical Editor
FRED. B. STANLEY, Engineering Editor
HARRIET B. JOSEPHS, Managing Editor
DOROTHY M. MARTIN, Associate Editor
LILLIAN C. ARDEN, Associate Editor
NICHOLAS HUPALO, Art Director

BUSINESS STAFF

ALAN S. COLE, General Manager

P. H. BACKSTROM — J. M. CONNORS
M. A. OLSEN — L. B. CHAPPELL

F. M. McQUILLEN, Production
R. G. GERMAISE, Circulation
WALTER S. ROSS, Promotion
E. SILEN, Readers' Service

Published the 5th of each month by Breskin Publishing Corporation. Publication Office, Twentieth and Northampton Sts., Easton, Pa. Executive and Editorial Offices, 122 E. 42nd St. (Chanin Bldg.), New York, N. Y. Phone AShland 4-0655. Mid-Western Office, 221 N. LaSalle St., Room 1338, Chicago, Ill. Phone Randolph 6336. Pacific Coast Office, 427 West 5th St., Los Angeles, Calif. Washington, D. C., Office, 1026 17th St. Also Publishers of Modern Packaging. Subscription price $5.00 per year, $8.00 for 2 years in U. S., its possessions and South America. Canadian subscriptions $5.50 per year, $9.00 for 2 years; all other countries, $6.00 per year, $10.00 for 2 years, payable in American money or its equivalent. Price 50c per copy. Printed in U. S. A. Entered as second class matter May 28, 1940, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations. Back numbers (except November) 3 months or more preceding current issues, when available, $1.00 each.

SEPTEMBER 1942

VOLUME 20 NUMBER 1

• GENERAL INTEREST

• PLASTICS ENGINEERING

• TECHNICAL SECTION

• NEWS AND FEATURES

PLASTICS...
where can we get the answers?

One good place to find out *How* and *Where* to use plastics is the Plastics Institute Research and Testing Laboratory—a centralized, *impartial* source of information on plastics materials, design, production methods and applications.

Plastics Institute has complete laboratory facilities and an experienced staff . . . to supply you with specific property tests on materials—for design and development of plastics parts and products to the point of commercial production—to make one-of-a-kind models—for thorough, accurate and confidential recommendations on methods and materials. This Consulting and Research service is available to industry everywhere in America.

Let Plastics Institute help your products meet post-war competition—reduce production costs—improve design, utility, styling. A good place to make your start in plastics, or answer knotty problems that arise, is Plastics Institute. A letter outlining your specific plans or problems will bring a prompt, helpful response.

BASIC LESSON ASSIGNMENTS

A fundamental knowledge of plastics is available in the Basic Lessons—issued as weekly assignments—or in complete Reference Library form. This course includes sources, history, properties and uses of materials (including synthetic rubber) . . . molding and mold design . . . laminating . . . fabricating . . casting and slush molding . . . testing . . . research . . . plant layout and operation . . . maintenance of equipment. Smart easy reading for spare time at home—to gain a basic knowledge of all phases of plastics.

Francis A. Gudger
President

John Delmonte — *Technical Director*
Dr. John P. Trickey — *Assistant Technical Director*

ADVISORY BOARD

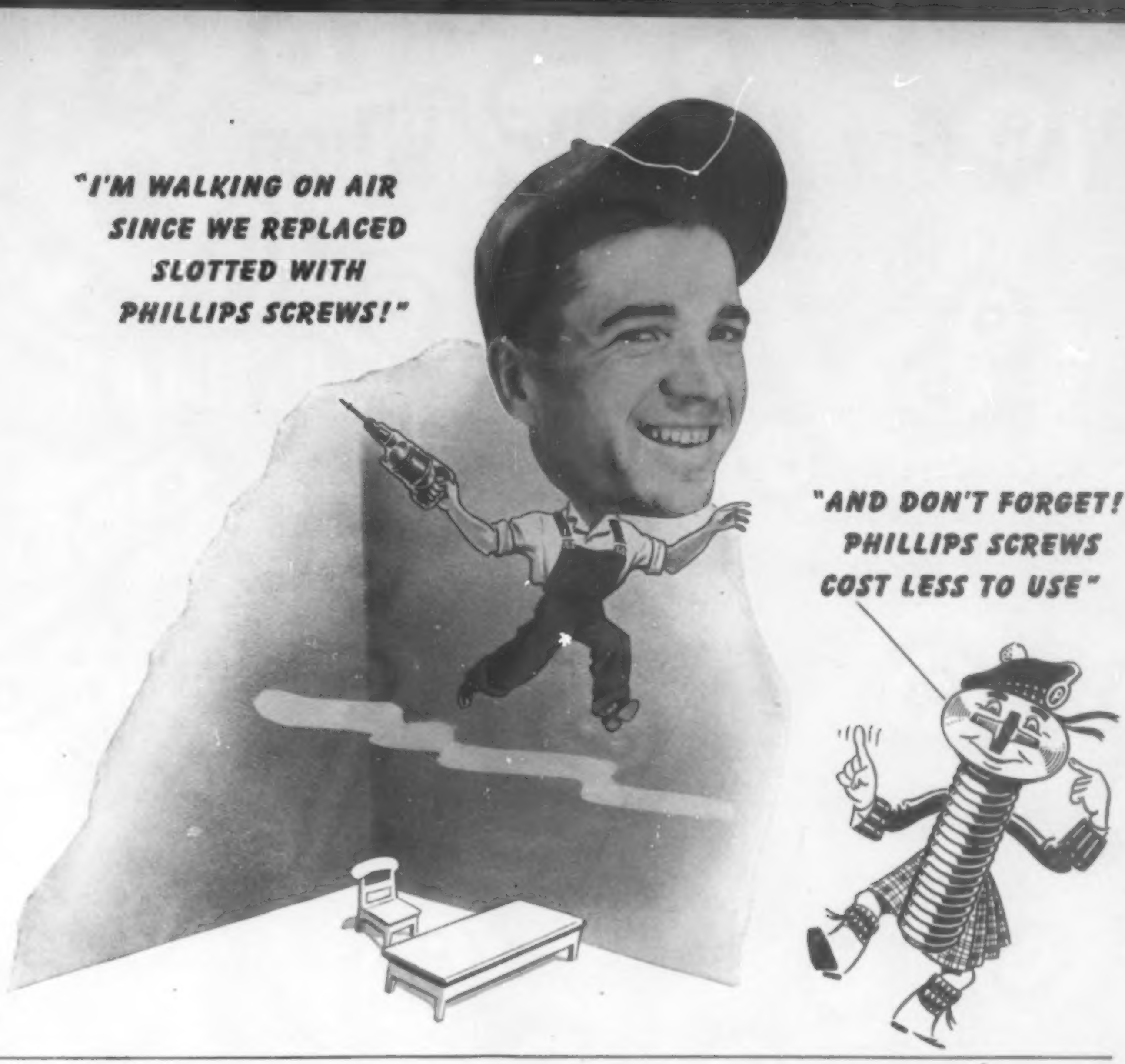
E. F. Lougee, *Chairman*

Donald Dew — *Diemolding Corporation*
Spencer E. Palmer — *Tennessee Eastman Corp.*
Dr. Gordon M. Kline — *Nat'l Bureau of Standards*
Louis M. Rossi — *Bakelite Corporation*

Plastics INSTITUTE

NEW YORK — 122 East 42nd St.
LOS ANGELES — 186 S. Alvarado St.
CHICAGO — 221 N. LaSalle St.

Training Division, Plastics Industries Technical Institute



Easier Work • Less Fatigue • No Production Slumps = 50% Less Assembly Time with Phillips Screws

Take a man who is being asked to put his "all-out" effort into assembly work.

You have been giving him slotted screws. Did *you* ever try to *speed up* using slotted screws? It's just inviting trouble, that's all; if you aren't slow and cautious, you'll end up with split screw heads, screwdriver scars and loose assemblies.

But give that fellow *Phillips* Screws and watch him go — particularly if he was using a hand driver before. With Phillips he can use power drivers — electric or pneumatic — for there's no danger of the driver point escaping from the screw recess. It's just a matter of . . . point the driver . . . and let her go. Phillips Screws drive straight automatically and can be "rammed home" without danger of the heads splitting.

No wonder a changeover to Phillips makes such a difference in output — quality — and employee morale. And the big saving in time also means an average of 50% saving in *cost*.

Write to any of the firms listed below for further facts on Phillips Recessed Head Screws.

PHILLIPS RECESSED HEAD SCREWS GIVE YOU 2 for 1 (SPEED AT LOWER COST)

WOOD SCREWS • MACHINE SCREWS • SHEET METAL SCREWS • STOVE BOLTS • SPECIAL THREAD-CUTTING SCREWS • SCREWS WITH LOCK WASHERS

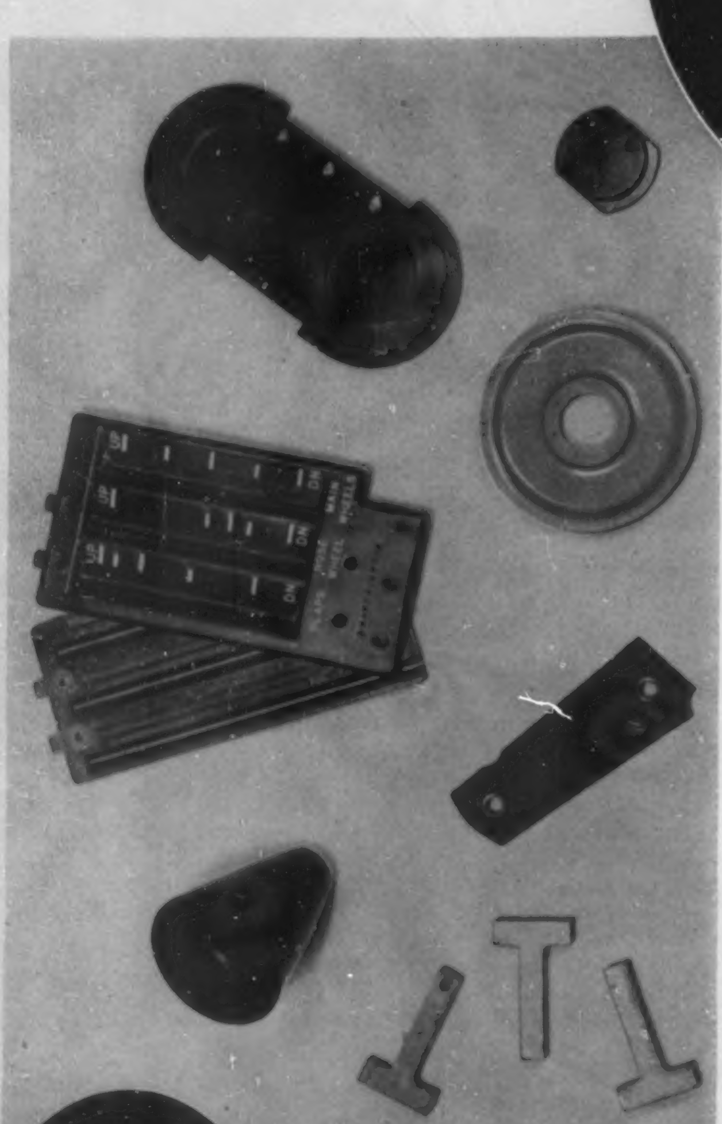
American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterbury, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N. H.

You Get ALL FIVE When You Use

1. High Impact Strength
2. Wide Range of Molding Shapes
3. Wide Range of Density
4. Combined Rigidity and Elasticity in the Same Piece
5. Distinctive Natural Texture

COLUMBIAN CO-RO-LITE Sisal Fillers

REG. U. S. PATENT OFFICE



Now—get this light, tough sisal filler, impregnated with thermosetting resin, all ready for shaping, molding and setting in your own plant.

CO-RO-LITE is a resin-impregnated batting made from tough sisal cordage fibers, and consolidated into a firm sheet by a needling operation that drives the fiber tufts through the mass. By volume, its composition is one part of fiber to six parts of void space, providing ample air space for complete penetration of the resin powder.

Flash molds may be used, and the density and specific gravity of the raw sheets are adjusted to your specifications. Sheets and molded shapes are readily produced suitable for cams, gears, bobbin heads, bearings, tension and compression members, abrasive disc hubs, cabinets, scabbards and other items. A highly useful characteristic of Co-Ro-Lite enables the blending of both elasticity and rigidity in the same piece, as a rigid hub with a flexible outer periphery.

- **Write or wire for physical data and production recommendations.**

ALLIED PRODUCTS DIVISION

Patent No. 2,249,888
Other Patents Pending

COLUMBIAN ROPE COMPANY
400-10 Genesee St., Auburn, "The Cordage City," N. Y.

Two ways we can help your war production...

PLAN

PRODUCTION

ROUGHLY, the two ways that Auburn can help your War Production are Plan and Production. That doesn't tell the exact story, for there are no one or two words that can be used to convey all we offer. As briefly as we can put it, here's how it is:

PLAN. When we say we have had more than 65 years' molding experience (starting with shellac), that means we've pioneered every step of the way. It's given us a reputation for doing the unusual, and frankly, we're proud of that. We like to crack the tough ones. And we also know when we're licked.

Which is why so many war-busy concerns consult our engineering department—first. It's a service that has proven most helpful in preparing to make new war products that they have not made before. Our help is yours for the asking.

PRODUCTION. We've always produced to close tolerances and exacting inspection standards, for a properly made and finished product keeps the assembly line flowing smoothly and evenly. Cuts down rejects, too.

That's the kind of work that keeps American production rolling at the pace to win.

Molders of all types of Thermo-Setting and Thermo-Plastic materials by compression, injection and extrusion methods.

MOLDED PLASTICS DIVISION

AUBURN BUTTON WORKS

AUBURN, NEW YORK

Ethyl Cellulose Plastic—Tough at 70°F. Below Zero!

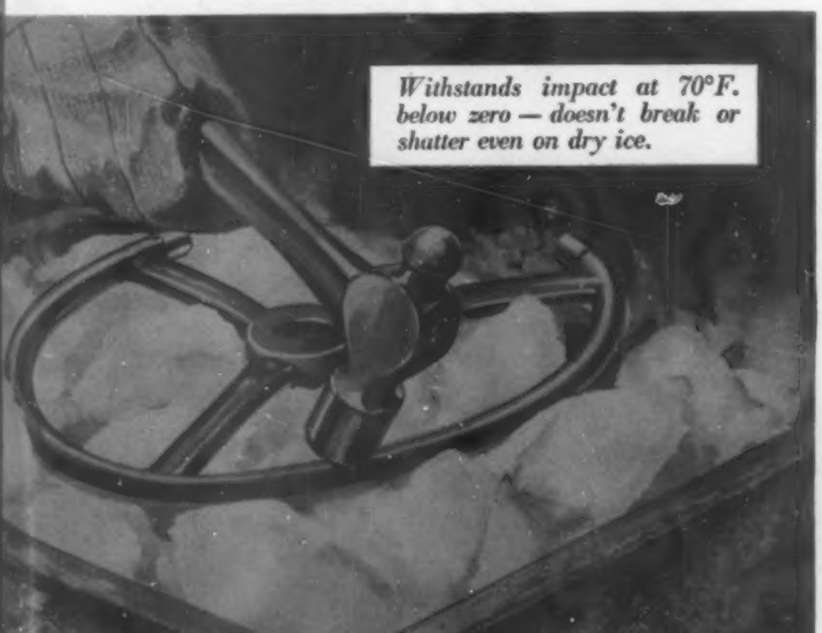
(WAR SUPPLIERS, PLEASE NOTE!)

Twist it, bend it . . . tough even at 70°F. below zero. There's the proof of the flexibility of this amazing plastic.

Ethyl cellulose plastic, developed through Hercules research, is easily formulated into a variety of products that need to be pliable, flexible, durable, and non-porous. Its inherent quality is toughness—maintained at the maximum low-temperature specifications of the Army and Navy. It retains adequate flexibility at minus 70°F. . . . withstands sudden changes from very low to high temperatures . . . and it resists oxidization even in contact with ozone.

It offers a wide range of formulations from solid pieces such as hard containers, knobs, and steering wheels to softer, rubber-like compositions such as sheeting and tubing.

We urge you to investigate the applications of ethyl cellulose to your own war products. We do not make plastics, but can supply you with technical data; and refer you to the plastic fabricators who are formulating from Hercules ethyl cellulose.



Withstands impact at 70°F. below zero — doesn't break or shatter even on dry ice.

THESE ARE SOME OF THE WAR POSSIBILITIES OF ETHYL CELLULOSE PLASTICS

MOLDED: knobs . . . steering wheels . . . fittings . . . handles.

EXTRUDED: on wire for insulation . . . tubing . . . strips . . . tapes.

COATINGS: on fabrics for gas masks . . . raincoats . . . stratosphere suits . . . decontamination bags.

★

HERCULES

ETHYL CELLULOSE

★

HERCULES POWDER COMPANY Incorporated · *WILMINGTON, DELAWARE*

DDu-33

NO WARP IN THE THIN SECTIONS

Mr. E. P. Rupprecht, Superintendent of The Chicago-Wilcox Manufacturing Company, Chicago, Ill., reports "We used to have considerable trouble with warpage in the thin sections of our intricate gasket dies. Graph-Mo steel has solved that problem and made our work a lot easier in other ways, too. Graph-Mo machines much easier than other die steels we've used and wears longer."

It will answer all your questions about this steel.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO
Steel and Tube Division

TO ASSURE VICTORY
BUY UNITED STATES WAR SAVINGS BONDS & STAMPS

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
GRAPHITIC STEELS

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

A BETTERMENT . . .

Not a Substitute

The modern dictating machine is not a substitute for the handwritten "copying ink" letter of the last century.

It is a BETTERMENT.

What executive could afford to go back to hand-writing his own letters? His competitors would soon outstrip him if he even dared try it.

Neither will forward-looking designers and engineers want to go back to habitually used, now hard-to-get, weighty, corrosive, costly materials. These men are discovering that CONTINENTAL-DIAMOND NON-metallics offer unique property combinations that make possible betterment of product, process and performance.

They have made such discoveries by bringing their "What Material?" problems to the C-D Research Laboratory. With FIVE C-D NON-metallic materials to use . . . with over 27 years of "know how" to draw upon . . . and free from any prejudice favoring one or two types of NON-metallics, the C-D Laboratory is usually able to work out an answer to most problems that definitely results in a BETTERMENT.

You can get acquainted with C-D NON-metallics through our Booklet GF-6. When you want Laboratory Research assistance . . . it's yours for the asking.

Continental-Diamond FIBRE COMPANY

Established 1895 . . Manufacturers of Laminated Plastics since 1911 — NEWARK • DELAWARE

The Taylor Flex-O-Timer gives you

TOP QUALITY AT TOP SPEED

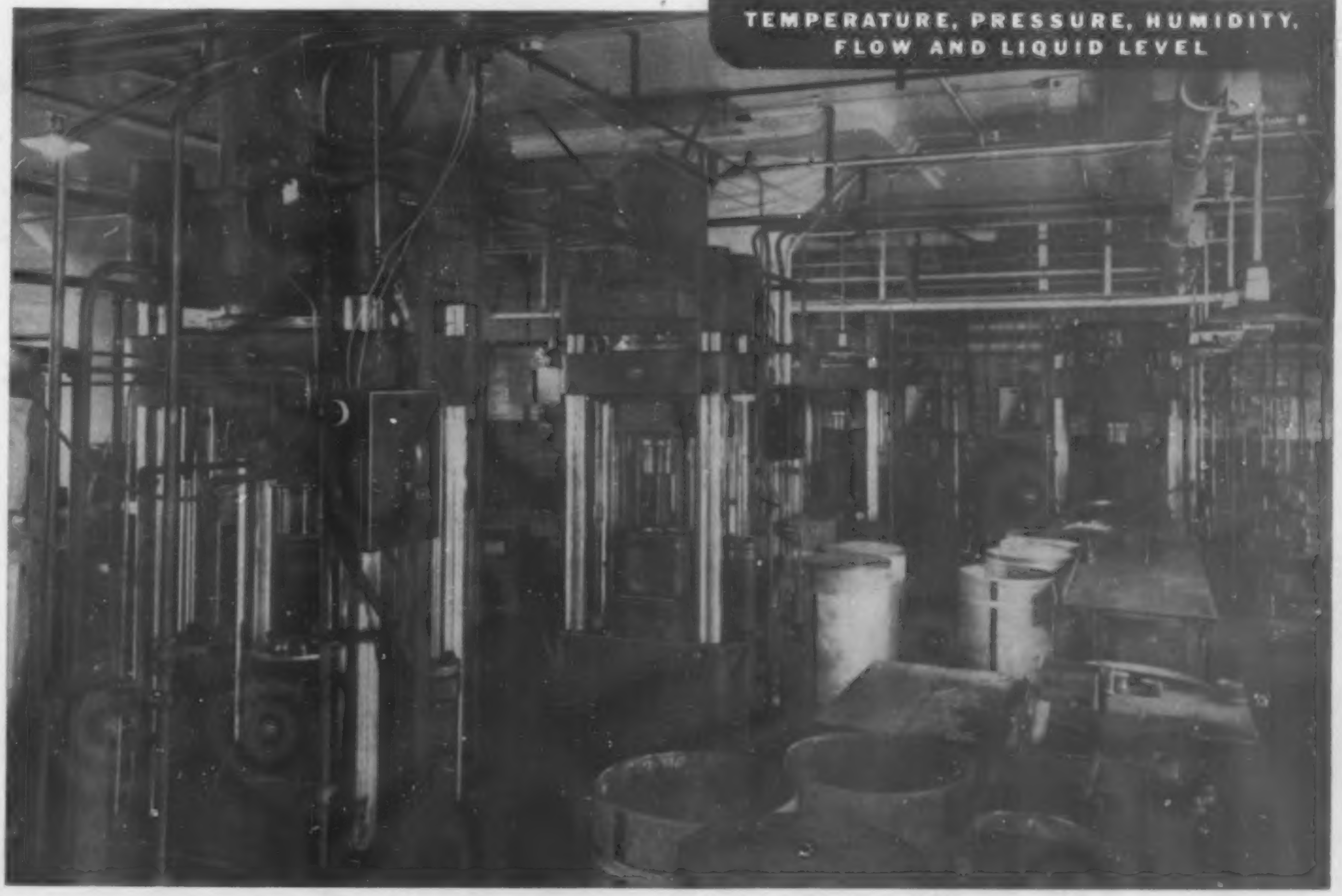
even with inexperienced operators

IF you're wondering how to get more and better production from your presses which may be manned by inexperienced operators, the Taylor Flex-O-Timer can take a big load off your mind. These Time Cycle Controllers permit synchronizing of operations so that the operator's work load can be planned for most efficient use of his time with *minimum physical and mental effort!* About all he has to do is load and unload the presses. All intermediate operations are performed automatically.

Taylor Flex-O-Timers have all the advantages of previous types of timers *without their disadvantages.* They start instantaneously. They can be used to time pneumatic or electric operations, or both. They simplify piping, because Flex-O-Timer's efficient leakless type air valve in most cases eliminates need for external pilot valve.

The war effort is calling for constantly improved production—and Taylor Flex-O-Timers can be a tremendous help! Why not get full details from your Taylor Field Engineer *at once*? Call the nearest Taylor office or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

Taylor Instruments
MEAN
ACCURACY FIRST
Indicating, Recording, Controlling
TEMPERATURE, PRESSURE, HUMIDITY, FLOW AND LIQUID LEVEL



ALL PRESS LOADS ALIKE . . . In this typical installation, two-pressure hydraulic valves, water and steam valves, and condensate and drain valves are operated in accurately timed sequence so that *all press loads are cured exactly alike!* Warping, blistering, rough surfaces, or discoloration cannot be caused by improper temperature or time. And when schedules require revision, the Flex-O-Timers are precisely adapted in a few minutes or even seconds. *Let Taylor Accuracy go to work for you!*

★ Engineers ★ Designers ★ Purchasing Agents

Here Are . . .

TIME SAVING CHARTS

For Specifying

PHENOLITE · Laminated Bakelite

The specifications charted below are the most common in use on war orders. They should be helpful to you when specifying or ordering material. You will note the corresponding grade of PHENOLITE after each classification. If *you'd like extra copies of these charts, please write us. We'll be glad to send them.*

FEDERAL SPECIFICATION HH-P-256

CORRESPONDING PHENOLITE GRADE				
HH-P-256 Grade		Sheet	Molded Tubing and Rod	Rolled Tubing
Type I	X	X-101	X-11, 12*	X-2,3,4,4-A
	P	XP-214,264	----	----
	XX	XXE-301	XX-25,26,26-A	XX-21,21-A,22,22-A
	XXP	XXP-209,259	----	----
	XXX	XXXH-401	XXX-36	----
	XXXP	XXXP-219	----	----
Type II	C	CO-501	C-45,CE-51-A	C-42
	CE	CEO-552	CE-52-A,52-B,57,57-A	----
	L	L-601,LE-651	LE-75	----
	LE	LE-653	LE-76-B,76-C	LE-62-A,63
Type IV	A	A-701	A-85	----
	AA	FAA-761	AA-87	----

*Not made in rod

NAVY SPECIFICATION 17-P-5

CORRESPONDING PHENOLITE GRADE			
Navy Type	Sheet (s)	Molded Tubing (Tm) & Rod (R)	Rolled Tubing (Tr)
PBE	XXXH-401	XXX-36	----
PBP	XP-214,264	----	----
PBG	XXE-301	XX-26	XX-22,22-A
PBH	A-701	A-85	----
PBM	X-101	X-12***	X-3,4-A
FBE	CEO-563-N	CE-52-A	----
FBG	CEO-552	CE-57	----
FBH	FAA-761	AA-87	----
FBI	LE-651-K	LE-76-B	----
FBM	CEO-551* CO-501**	C-45	----

*Less than 1" thick **Over 1" thick ***Not made in rod

NATIONAL VULCANIZED FIBRE CO.

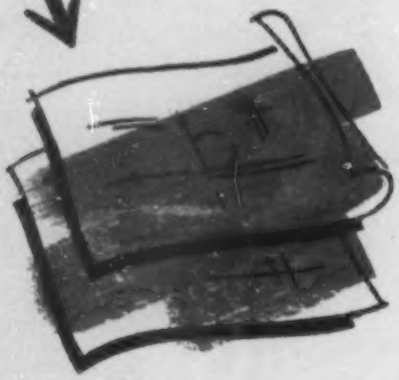
WILMINGTON DELAWARE

Offices in Principal Cities

★ ★ *Broadening American Enterprise through Dependable Plastics* ★ ★ ★

Between DESIGN and PLASTIC PRODUCT

stand the MEN at the machines



Meet two of the best in the business, Stan and Bill: men whose eyes and heads and hands complete this job of turning blueprints into molded plastic parts. How do we know they're so good? Well:

The Society of the Plastic Industry has just announced the awards in a nation-wide competition for men at the machines . . . men who have made the most outstanding solutions of molding problems. Prizes were awarded in 5 categories.

Bill (that's William Dietzen) walked off with the M. M. Makeever Award for the best achievement of the year in running a compression molded phenolic piece. Stan (Stanley Shauver) won the Frank Shaw Award for the most outstanding job of running a transfer molded part. And Bill and Stan won these awards, not for anything out of the ordinary run of their work, *but just for the kind of jobs they did on regular orders passing through production.*

We're proud of Stan and Bill, here at Chicago Molded Products—proud that, out of five awards, two came to the men in our plant. And we're proud of the fact that we can offer their services — and those of hundreds of other equally skilled men — for the job of smoothing out your plastic molding problems.

Two S.P.I. winners! Bill Dietzen (above), winner of the M. M. Makeever Award. (Below) Stan Shauver, Frank Shaw Award winner.

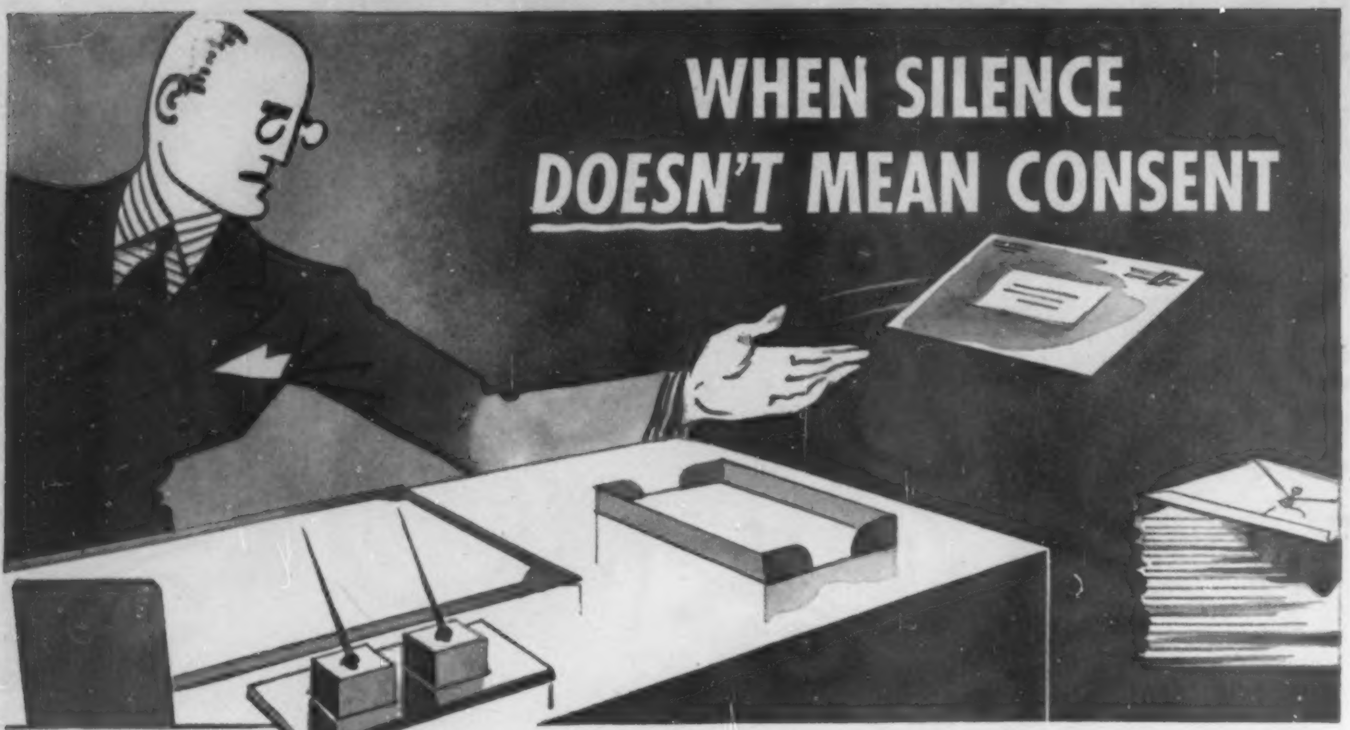
COMPRESSION
INJECTION
TRANSFER
EXTRUSION
MOLDING OF ALL PLASTIC MATERIALS

CHICAGO MOLDED PROD. CORP.

CHICAGO MOLDED PRODUCTS CORPORATION

1020 North Kolmar Avenue, Chicago, Illinois

FOR THE PLASTICS INDUSTRY
Hydraulic Presses...
...by R. D. WOOD
R. D. Wood Hydraulic Presses for the Plastic Industries are built in a comprehensive standard line of many types and sizes. In addition, special presses are constantly being developed for special requirements. High production, ease of operation, low maintenance and long life are characteristics of every Wood press — standard or special. We invite consultation on any hydraulic press problem.
WOOD
WOOD
At right: A precision type, open-side Belt Press; At left, an 8-opening steam platen Press operating on 2000 pounds per square inch working pressure, with Platens 40" x 40".
ESTABLISHED 1803
R.D. Wood Co.
PHILADELPHIA, PA.
HYDRAULIC PRESSES AND VALVES FOR EVERY PURPOSE
Right: This 10-opening 2700 ton steam platen Press is equipped with special elevator (patent pending) for maximum speed in loading and discharge. Left: A 570 ton Hydraulic Laboratory Press. Two 8½" openings between 22" square electrically heated hot plates; temperature controllable to 850°F.; two-pressure pumping unit; adjustable pressure control.
WOOD



—or How To Tell a Stacker!

STACKERS are people who subscribe to publications but seldom read them. They allow unread copies to pile up on window sills or on top of filing cabinets—wasted circulation for advertisers.

Fortunately stackers don't renew. There is nothing that stays the hand from signing a renewal order and another check as effectively as a pile of unread publications.

According to A.B.C. rules, silence *doesn't* mean consent. Subscriptions up to three months in arrears are reported accordingly in A.B.C. reports and after that the subscriptions are stopped or reported under the heading of "unpaid distribution". Non-readers can get on the list of an A.B.C. paper but few stay on.

This regular report on the extent of reader interest, as expressed by renewals and governed by the advertisers' own definition of paid circulation, is just one of the reasons why a business paper's membership in the Audit Bureau of Circulations is so helpful to both advertisers and publishers.

This business paper is a member of the Bureau. In addition to the percentage of renewals and arrearages, our A.B.C. report tells advertisers how much paid circulation we have, how it was obtained, how much readers pay for it, where it goes, the business or occupational analysis of subscribers and many other facts that buyers need in order to invest their advertising money most successfully.

SEND THE RIGHT MESSAGE TO THE RIGHT PEOPLE

Paid subscriptions and renewals, as defined by A.B.C. standards, indicate a reader audience that has responded to a publication's editorial appeal. With the interests of readers thus identified, it becomes possible to reach specialized groups effectively with specialized advertising appeals.

MODERN PLASTICS

Member of the Audit Bureau of Circulations ABC ***Ask for a copy of our latest A. B. C. report***

A. B. C. = AUDIT BUREAU OF CIRCULATIONS = **FACTS** AS A MEASURE OF CIRCULATION VALUES


They Asked For it
TOUGHER - SAFER - CLEARER
PLASTICS • • • By REYNOLDS
REYNOLDS has joined up with the combat forces and is stripped down to fighting action. Its new, versatile sheet forming set-up of clear materials for aeroplane windows, turret blisters, canopies, etc., is just another Victory aid by America's oldest and most experienced plastic molder.
No matter what your plastic problems . . REYNOLDS' engineers are ready and eager to serve you.
SALES OFFICES
MINNEAPOLIS . . . Atlantic 3265
ST. LOUIS . . . . Franklin 2790
DETROIT . . . . Madison 5011
CHICAGO . . . . Monroe 1271
NEW YORK . . Lexington 2-3030
BUFFALO . . . . Grant 8567
CINCINNATI . . . Cherry 2422
WICHITA 2-3712
CLEVELAND . . . Cherry 7744
RMP
REYNOLDS MOLDED PLASTICS
CAMBRIDGE, OHIO, U. S. A.
DIVISION: REYNOLDS SPRING COMPANY • JACKSON, MICHIGAN, U. S. A.

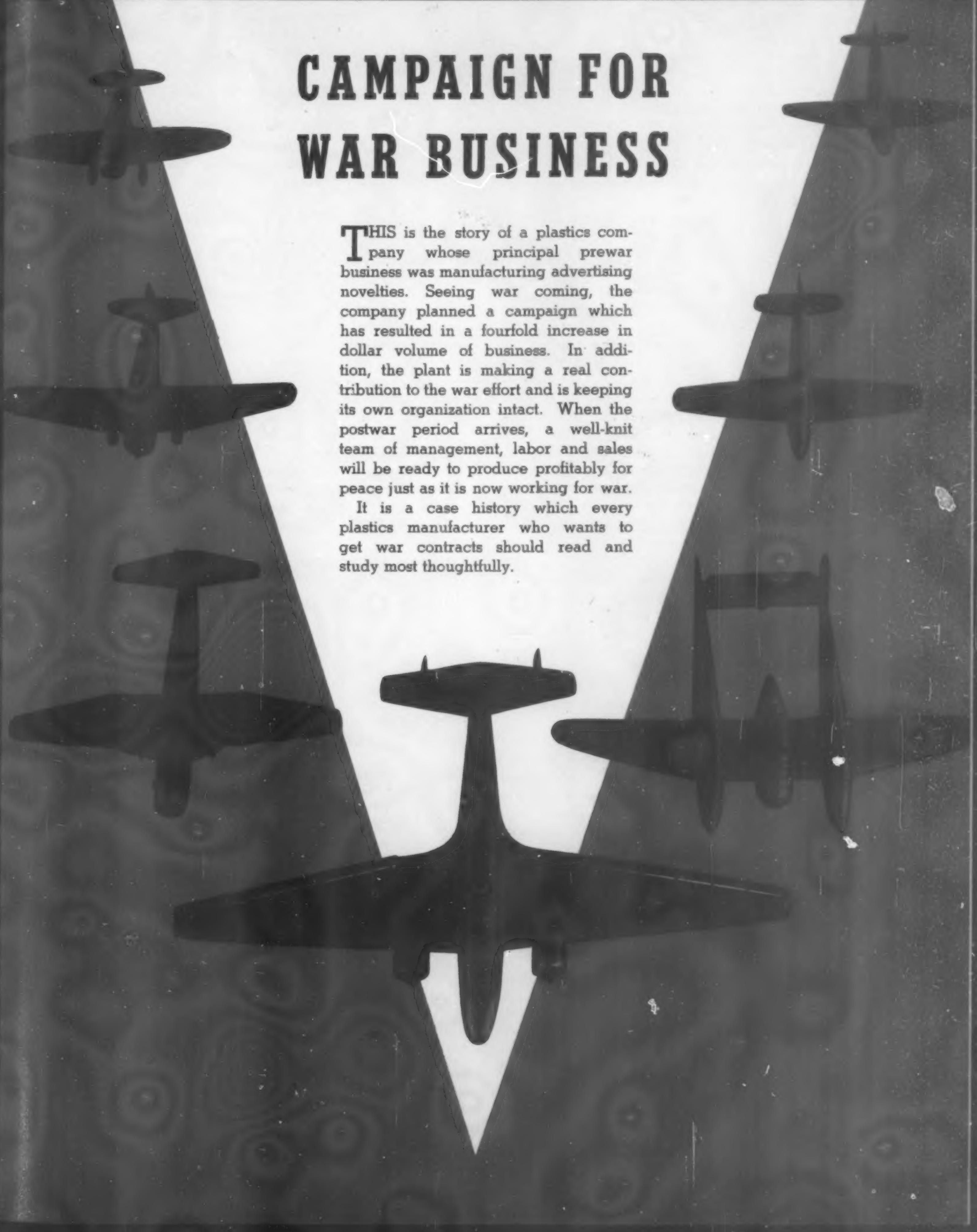
Modern Plastics

SEPTEMBER 1942 VOLUME 20 NUMBER 1

CAMPAIGN FOR WAR BUSINESS

THIS is the story of a plastics company whose principal prewar business was manufacturing advertising novelties. Seeing war coming, the company planned a campaign which has resulted in a fourfold increase in dollar volume of business. In addition, the plant is making a real contribution to the war effort and is keeping its own organization intact. When the postwar period arrives, a well-knit team of management, labor and sales will be ready to produce profitably for peace just as it is now working for war.

It is a case history which every plastics manufacturer who wants to get war contracts should read and study most thoughtfully.



SIX months before Pearl Harbor, the Cruver Mfg. Co., Chicago, Ill., held an M-day meeting. Out of it came a comprehensive plan for finding uses for plastics in the war effort which has increased the business of the company from 300 to 400 percent in dollar volume, has kept the machines going and—probably most important of all—has maintained the production and sales staffs intact.

In that initial meeting Cruver's vice-president and general manager, Charles C. Livingston, told his conferees that from that moment on the company was going to operate as if the country were at war. Then he asked for suggestions as to how *specifically* the company could secure war business.

CHARLES C. LIVINGSTON

The three-point plan that evolved was: (1) Not to accept any new business except that directly related to the war; (2) to take care of old customers as far as possible; (3) to go out and really get war business.

The third point was, of course, the most difficult to carry out. But it was done through careful planning and intelligent application of that planning. The company engineers, salesmen and management personnel checked the entire field to find out where there was a likely market for plastics. From this survey it was determined that the armed forces and in particular the air services, in whose equipment lightness in weight combined with good flexural and tensile strength are important, were the biggest potential customers. Men were sent to every one of these possible sources of business to see whether the company's idea that there *was* business could be translated into actually getting contracts.

As an example of how this was done, Mr. Livingston cites the changeover in the New York office. In that office were four sales engineers who had been with the company for a number of years but who were not getting war business. Principally they were getting business in civilian items formerly made from metal which had been redesigned for plastics when metal became unavailable. Obviously this type of business did not fit into the M-day plan, so it was decided to send these men to Washington.

Not wishing to dislocate the salesmen's homes or put a severe financial burden upon them, a method was worked out whereby one man would go to Washington for a two-week period, come back to New York with full report of his activities and turn everything over to the next man who, in turn, would go to Washington for a two-week period. By such rotation, the men could continue living in New York and thus maintain their homes and social connections. In addition, they did not add to the already crowded housing conditions in Washington.

Permanent quarters were taken in one of the Washington hotels, where the man currently in residence had both his office and living quarters. An arrangement was made for equitable distribution among the four men of all profits from Government business. The company realized that the cumulative effort of all four would be responsible for such business, and the mere fact that one man managed to land a particular contract should not entitle him to the entire proceeds. This has worked out ideally and a close team cooperation among the four men has been the result. From the company's standpoint, both present and future, it has meant additional business.

The company did not stop with outlining a campaign and making ordinary sales presentations. In addition to the usual sales methods, two special booklets were prepared specifically designed to sell Government contracting officers on the firm's ability to handle any job they might get, and on the practicability of using plastics.

These books (Fig. 1) are attractively bound with pearl-like covers cut from cellulose acetate sheet held together by a plastic backbone. Realizing that one picture is more effective than a thousand words, the company took carefully worked-out photographs showing its plant and equipment in operation, its clerical and office staffs at work, and views of the building in which the plant is housed. These were gathered together and set in transparent acetate envelopes which are bound into one of the books. In the second book are pictures of outstanding plastic applications made by the company. As more and more war contracts were secured, photographs of finished products made under these contracts were added to the manual. The result is an impressive visual proof of the company's production capabilities.

Featured in one of the booklets is a one-page statement of the company's facilities. This facility sheet has been commended by many Government officials and copied by a number of other contractors seeking war business. Listed on it is information under a number of heads.

DO'S AND DON'TS IN GETTING WAR CONTRACTS

DO	*DON'T*
1. Be factual and specific.	1. Conduct a direct mail campaign for attention purposes. This is annoying to Government officers, wasteful to you, and usually ends up in the wastebasket.
2. Be prepared to prove statements.	2. Try to conceal cost and profit figures from Government men.
3. Set delivery dates which you are positive of keeping.	3. Set delivery dates optimistically with no allowance for unforeseen mishaps.
4. Remember contracting officers of the Armed forces are extremely busy. If you are kept waiting, hold your temper.	4. Make any extravagant claims for your products which you can't live up to. You end up in trouble.
5. Keep your appointments promptly.	5. Try to sell your product except on jobs for which it is suited. If you know it won't do a job as well as the material you are trying to replace, say so.
6. Have adequate identification.	
7. Make your appointments by telephone in advance.	
8. Have your prices right the first time.	

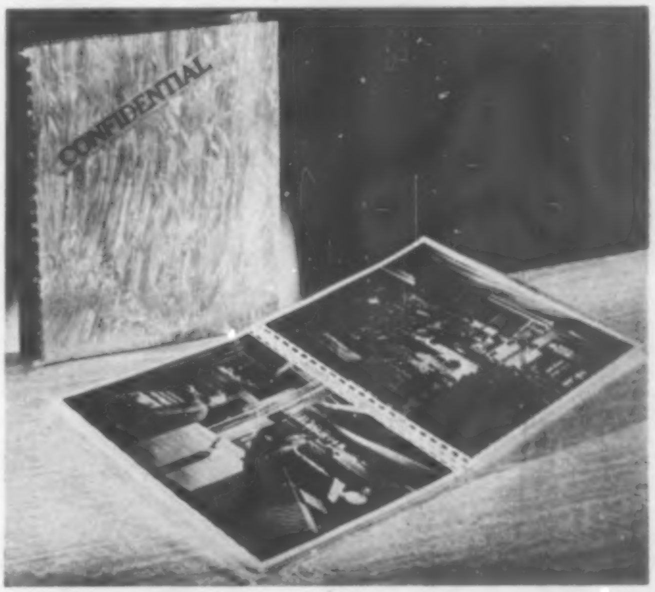
Main office and plant
Branch office
Officers
Bank
Financial rating
Sales volume
Official to contact on various matters pertaining to company operations
Floor space
Fire control apparatus
Power
Shipping facilities
Employees (number, lack of labor trouble, breakdown as to skilled and unskilled)
Prime products (which the company has produced or can produce)
Customers (former satisfied customers)
Representatives
Building
Number of shifts
Principal suppliers
Received contracts from following (other Government bureaus)
Facilities (a complete list of all machinery and equipment)

In this manner, every possible piece of information which a Government contracting officer might want to have was set forth in concise, readily understood and completely pictured form. Many weeks of effort went into the planning and producing of these books, but that effort has been repaid by an ever-increasing amount of business.

This molder now has many war contracts and is getting more every day. However, with characteristic thoroughness, he has not stopped with securing these contracts. Realizing that the employees must be made to feel that they are the army behind the Army, he has attacked successfully the problem of maintaining employee morale.

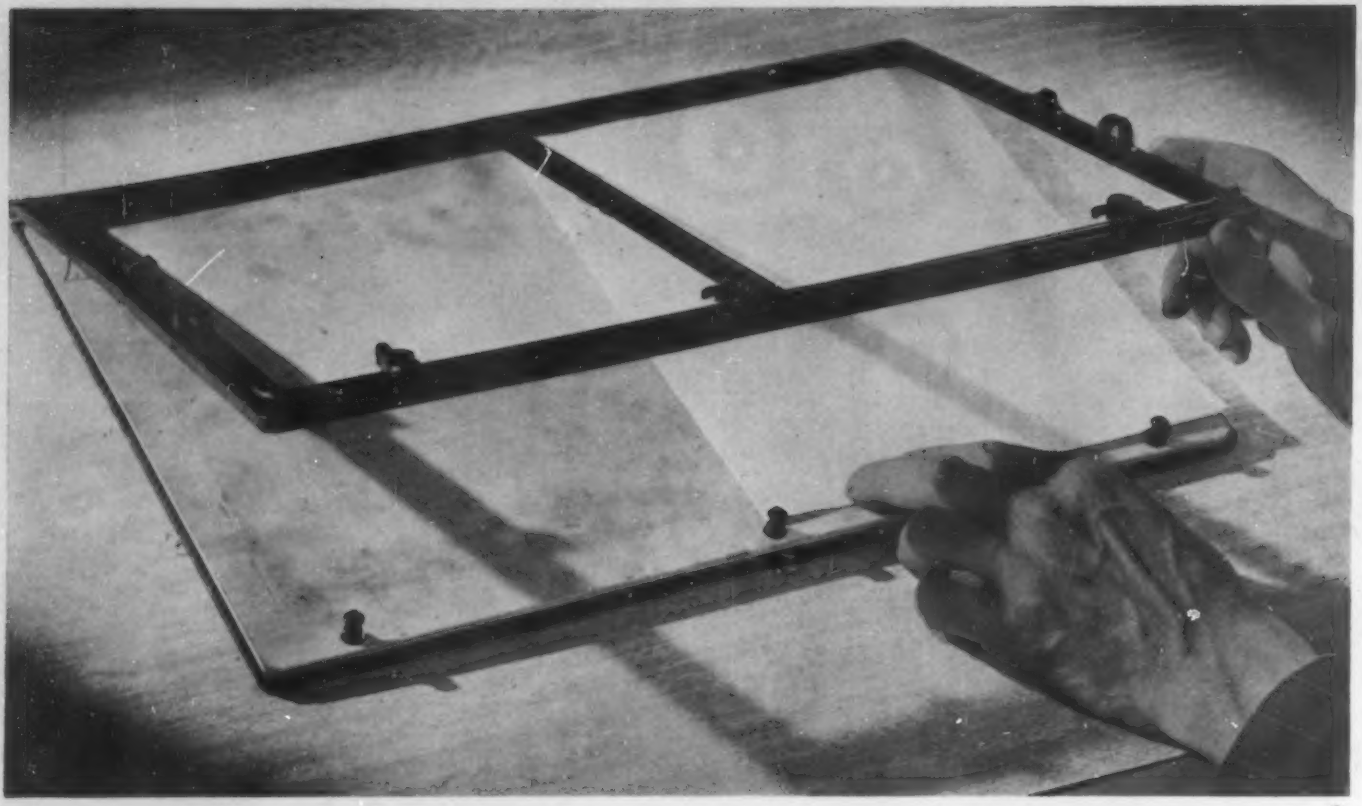
In regular assemblies, speakers from the War and Navy Departments talk to company employees from a specially built stage in one of the factory buildings. They emphasize the need for speed and accuracy, and try to bring home to the Cruver people what the work they are doing means on the battlefront. Results are what could be expected: good labor

1



1—Pictures instead of words tell the graphic story of one molder's contribution to the war effort. Equipment, personnel, buildings, finished products are all shown in this plastic-bound booklet. 2—The study of accurate, completely detailed model planes enables airmen and ground crew to identify enemy or friendly planes at a glance. Models are molded of durable cellulose acetate, and constructed to exact, accurate scale. Note the complete details of the models shown

2



3

3—Previously made of aluminum, this bomb recorder frame has been successfully converted to injection molded cellulose acetate plastic, constructed with reinforced rib for added strength

relations and an efficient, cooperative working staff, integrated in its thinking and in its desire to do an A-1 job of producing for war. As a result of this carefully thought out and well executed program, the company is now producing 100 percent on prime war contracts.

The history of some of these war applications—the problems involved in designing and molding—make an interesting story. "We had to keep in mind at all times," Mr. Livingston said, "that the converted article had to stand up under all tests equally well with the product made of critical or unsuitable materials that it was replacing. We are making a great many products that have been converted to plastics which we are not free to talk about because of wartime restrictions. We are free, however, to discuss the model planes, aerial dead reckoning computer, bomb recorder frame and true airspeed computer."

Model planes

Model planes for identification purposes have become an essential part of the war program. Through perfect models, airmen and ground crews learn to identify a ship by its silhouette. It is essential that these models be absolutely true to scale, 1 in. to 72 in., and absolutely perfect in every detail particularly in identification points because it is as necessary for our men to be familiar with our own ships as with enemy ships.

Originally, model planes were molded of rubber, which at its best could not be considered satisfactory, especially on large planes where there was a tendency to cold flow. They were later made of cast metal, which made a beautiful job, but the planes were exceptionally heavy and would break if dropped. Subsequently, planes were molded of reinforced plaster compound, which did not make a thoroughly clean job. The appearance of the finished plane was rather lumpy and, of course, if the plane were dropped, it would shatter. This factor immediately set up a serious objection to planes of this type, especially since they had to be shipped overseas and might arrive in a damaged condition. The very lives of our airmen depended on these model planes arriving not only unbroken, but perfect in every detail.

The Cruver company moved into the picture by recommending planes molded of thermoplastic cellulose acetate. Models of U. S., English, Russian, Japanese, German, and many another plane are now being produced in quantities. Perfect in every detail and accurate in scale measurement, the planes won't shatter or break when dropped from a reasonable height and can be shipped abroad with confidence. The models are made in a single cavity mold and are produced at a rate of from 35 to 60 an hour. The larger planes are made in two separate pieces which are put together.

In addition to the accuracy, durability and strength obtained, an outstanding advantage of the use of plastics has been the substantial daily production in comparison to the small production possible with the plaster of Paris method. Furthermore, each plane that comes off the mold is as accurate as the plane before it, which is the most important factor throughout the program of reproducing these exact plane facsimiles. Astonishingly fine detail must be maintained throughout. The wings have to be perfectly shaped from front to back, and must have perfect alignment from fuselage to wing tip. Gun mounts must all be indicated accurately and in their proper position. All undercarriage markings, such as bomb bays, retracting wheels, etc., must be in their proper places, in proper perspective and absolutely accurate.

The accuracy of the models is excellent, particularly since

the molder had to work from a combination of photographs and drawings and not from a set of blueprints. On one plane some sections are exceptionally thick, others thin. A few of the models produced are pictured on the first page of this story. In Fig. 2 the small and large plane, each to absolute scale, are shown for contrast of size. Note the complete detail in each, though the wing spread on the smaller is approximately equal to the width of the four-motored plane's tail.

Aerial dead reckoning computer

This computer originally had a plastic slide with an aluminum housing. On the one side of the housing are very accurate calculations determining the drift of the plane, together with a compass. On the other side is a computer for air speed and altitude. The instrument itself must of necessity be most accurate, and when reading the slide at the center line you have a plus or minus of .002 inch.

The slide is made of a vinyl sheet cut to size, printed and laminated on two sides with transparent vinyl resins. The housings, originally aluminum, subsequently converted to brass weighing 2 lb. and now converted to plastic, is injection molded-in sections in a two-cavity mold. The plastic housing is assembled only by the use of four brass rivets and four screws and inserts, together with two short springs. A line assembly belt speeds operations. The lettering is filled in with fluorescent paint. The overall size of the finished housing is $4\,^7/_8$ in. by $9\,^5/_{16}$ in., and the completed molded unit weighs .6 lb.

The conversion to plastic will save many tons of brass, if the total quantity of items ordered is considered. In addition to the actual saving of the critical material (brass), the molded piece is a much lighter weight for the plane to carry.

Bomb recorder frame

In its search for possible items for conversion, the company found the bomb recorder frame could be injection molded of plastics. This recorder, previously made of aluminum, consisted of two pieces hinged at the long end, closing together snugly over a tailored piece of three-ply wood. Two pencil holders are provided, one at each side. When closed, the frame must be held fast by hinged clips. The three-ply insert acts as a stabilizer for rigidity.

The die was quite involved and necessitated a cam action. The frame is cellulose acetate, with matte finish. A reinforced rib gives additional strength to the molded part. A large piece, the frame size is $7\,^1/_4$ in. by 12 inches. The wall thickness is .093 inch.

By converting this job from aluminum to plastic, the company released 1500 lb. of aluminum for each thousand pieces produced, which over the total quantity amounts to a very sizable poundage of aluminum saved. The plastic job can be considered as superior to the aluminum original both from a practical and from an eye-appeal point of view.

True air speed computer

Used to determine true air speed, this computer is made from vinyl sheet. The lettering (Fig. 5) is fluorescent. The cursor arm was originally machined out of methyl methacrylate and a thin strip filled in with fluorescent material. The molder changed this job from a machine operation to injection molded methyl metacrylate, thus saving valuable machine hours on a type of machine that is needed in tool and die work. Production is much in excess of that from the milling machine or the shaper. In addition, the job is considerably cleaner and more attractive even before finishing operations.

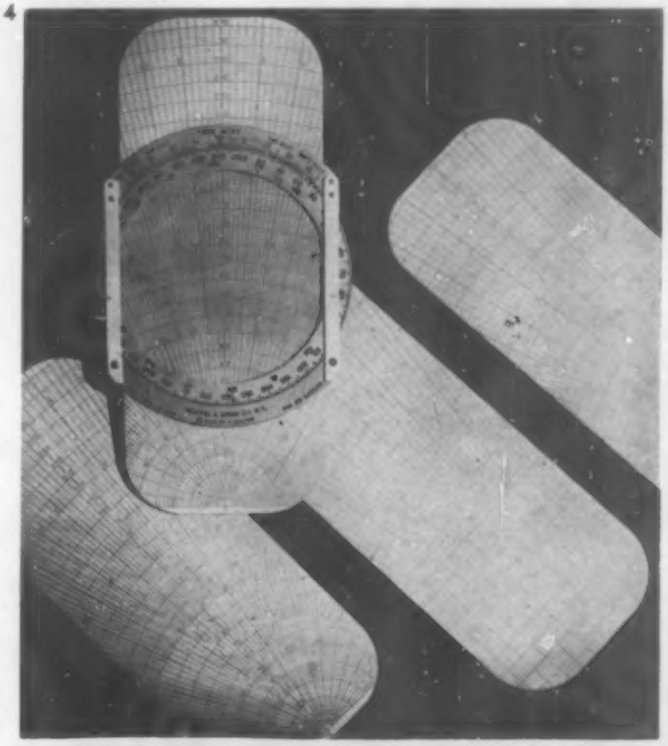
Government business

The Government is now the Number One customer of all business. Contrary to the thinking of many firms, an intelligent sales approach backed up by production performance is even more important in selling the Goverment than in selling private customers.

Credits—Material: Lumarith, Nixonite, Tenite II, Vinylite

4—Two aircraft instruments represent important conversions to plastics. The aerial dead reckoning computer now has an injection molded housing, and a slide of vinyl sheet, printed and laminated on two sides with transparent vinyl resins. 5—Computer to determine true air speed now made from vinyl sheet with fluorescent lettering and a molded methyl methacrylate indicator

4



5

IT is with considerable pride that we announce the appointment of Raymond R. Dickey as editor of MODERN PLASTICS.

Mr. Dickey has been in journalism for some ten years, connected with numerous trade papers and newspapers. His last position was on the staff of the Research Institute of America as their Washington editor. Since April of this year, he has acted in a similar capacity for MODERN PLASTICS.

Mr. Dickey was educated in Washington public schools, and was graduated from Southeastern University of Washington, D. C., with the degree of LL.B. He is a member of the bar of the District of Columbia.

We feel that Mr. Dickey is well qualified to carry on the traditions and ideals of MODERN PLASTICS magazine.

Charles A. Breskin

Molding the Thunderer

1

IN one of the occupied countries of Europe, a small boy fishing by a roadside stream was ordered by a group of Nazi soldiers to guide them to the nearest village. As he trudged along beside them, the lad entertained his captors by whistling imitations of bird calls. So amused were the Germans by this artless mimicry that not one of them noticed, when the party entered a wooded stretch of road, that he whistled 48 distinct times the call of the meadow lark, and twice that of the cuckoo. To guerrillas hidden in the woods, those whistles were a prearranged signal: 48 men, 2 machine guns . . . .

The U. S. Army, which cannot hope to find such vocal virtuosity in its personnel, has heretofore relied on a whistle of brass for the signalling done by company officers and non-commissioned officers in combat and in training. Now the Quartermaster Corps has specified a lightweight plastic whistle, designed by its own technicians, to replace the brass signaller as a general issue item. Known somewhat ominously as the "Thunderer Whistle," the new attention-getting device will be attached to a metal chain which is hooked to the coat or shirt, and worn in the whistler's pocket (see Fig. 1).

Alert to the necessity for conserving metal, the Quartermaster Corps, charged with the responsibility of feeding, clothing, equipping and transporting the Army, has long made a practice of introducing plastics into Army equipment wherever they represent an improvement over currently used materials or wherever they are more economical.*

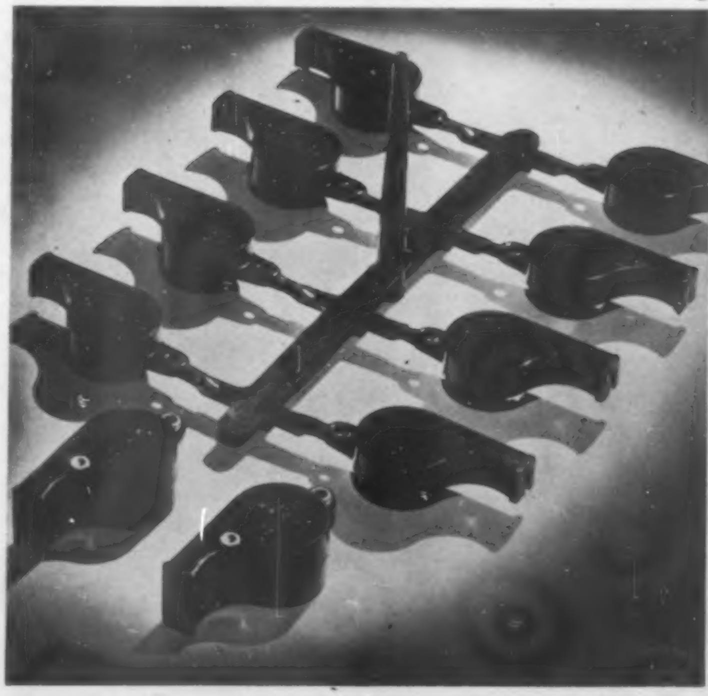
The Plastics Sub-Unit of the Quartermaster Corps' Standardization Branch studies carefully the possibilities of plastics in various applications before they are selected. For the Thunderer Whistle, a medium impact phenolic molding material was at first specified; but when it was brought to the attention of their technicians that a sufficiently hard thermoplastic material would perform equally as well as one that is thermosetting, the specifications were amended to permit use of the former.

One molding company now in production on the Thunderer is using a thermoplastic—a special grade of exceptionally hard cellulose acetate butyrate which, it reports, presented at first a multitude of molding problems. (*Please turn to page 120*)

* Recent issues of MODERN PLASTICS have carried stories on other items of Quartermaster Corps equipment incorporating plastics: phenolic-laminated helmet liners (May 1942, p. 35); resin-bonded skis (*ibid.*, p. 50); vinylite-coated cloth raincoats (July 1942, p. 40). Mess kit knife handles, toothbrushes, razors, combs, buttons are further examples of plastics replacements used by the Quartermaster Corps.

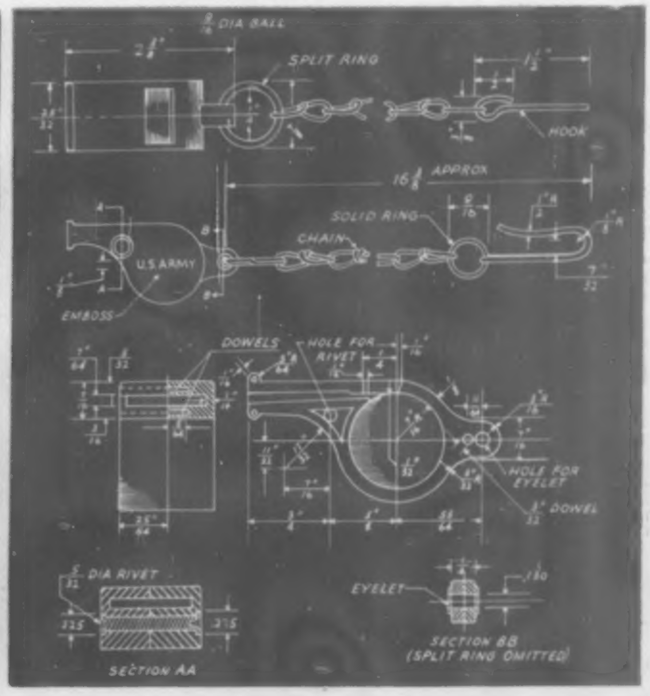
2—Cellulose acetate butyrate whistles are injection molded in two halves, four to a sprue, assembled with brass rivet and grommet. 3—Blueprint shows design of the Thunderer

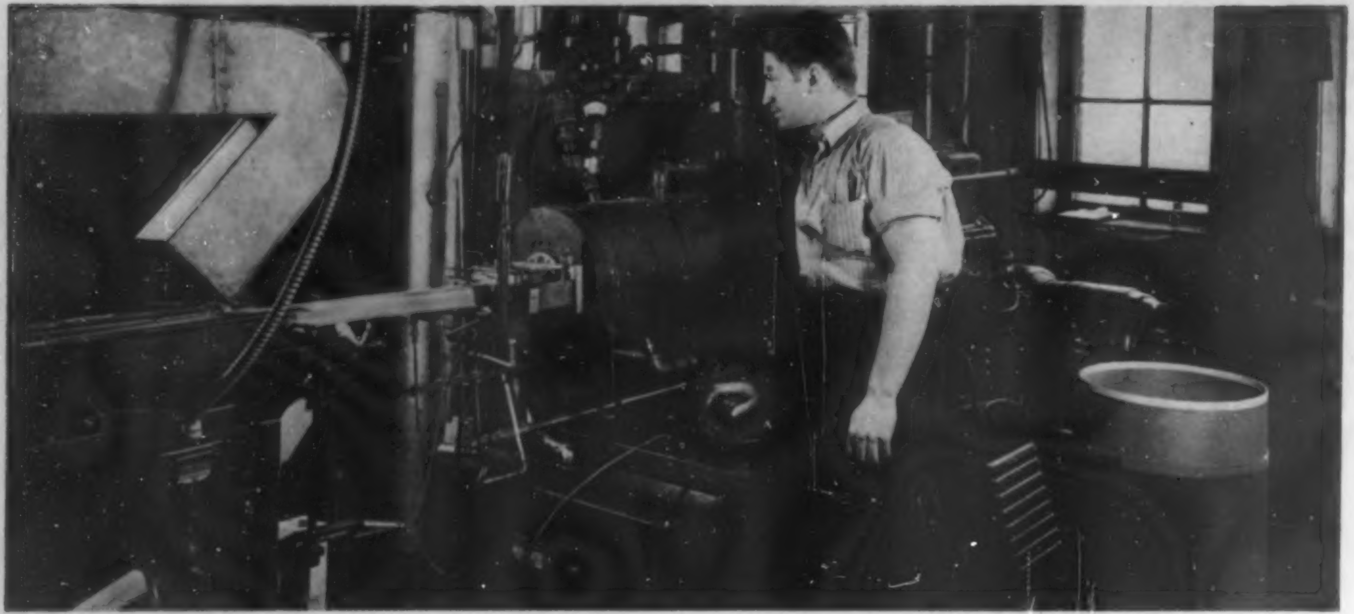
PHOTO, COURTESY TENNESSEE EASTMAN CORP.



2 PHOTO, COURTESY PLASTIC ENGINEERING, INC.

3





1

Wide extrusions

THOSE who read their newspapers carefully come upon many an ominous prediction of a copper shortage. Hints that pennies may be snatched from babies' banks—that they won't be made of copper any more—even that they'll be made of plastics! So far, the plastic penny is no more than a rumor, but plastics are today releasing copper in other significant applications. The U. S. Navy, already a large user of plastic materials, has recently adopted extruded vinyl for flashing and capping strips formerly made of the red metal.

Five hundred thousand feet of the extruded vinyl material, in widths from 5 in. to $6^3/_4$ in., have been ordered by the Navy from one manufacturer for use on a naval supply depot in an Eastern State. A special color of weathered copper has been specified to make the substitution of materials as unobtrusive to the spectator's eye as possible.

But color is distinctly a secondary consideration in this unique plastics development. The main job of the material is protection against leaks. Flashing is placed around buildings (continuous), over windows, under monitor sills as roof cap flashing, and as eave cap stripping. Eave cap stripping is a seal over the tops of exposed walls at the main roof and monitor roofs as a protection against moisture.

The material that does this job must be weather-resistant, water-resistant, sun-resistant, cold-resistant and dimensionally stable as well as resistant to aging. After extensive tests of the vinyl material extruded in various profiles from 5 in. to $6^3/_4$ in. wide, it was found to meet the Navy's specifications for the job. The extraordinary width of these profiles is noteworthy, of course. They are probably the widest shaped pieces ever commercially extruded in uniform thicknesses. Gages are maintained at .020 in. except at certain bends where additional strength is required.

The secret of this unusual (*Please turn to page 124*)

1—Cap stripping is extruded at the rate of 9 or 10 ft. per minute. Pick-up conveyor belt at left keeps the material moving under cool air blowers. 2—As it comes from the conveyor, stripping is measured into 8-ft. lengths, cut with shears

2

Low pressure laminating

by JOHN D. NELSON and G. F. D'ALELIO*

SCARCITY of basic raw materials and the necessity of finding replacements for metal have placed low pressure laminating of fabrics and paper base materials squarely in the spotlight.

The use of low pressures in the bonding of laminates, particularly wood veneer, first came about during World War I, in the manufacture of curved sections of plywood. In the intervening years several methods of fabrication involving variations in the basic rubber bag or diaphragm process have been developed.

Applications which naturally suggest a low pressure laminating technique are those which are not easily laminated by the conventional high pressure methods, but still require to a large degree the toughness obtained from the continuity of fiber in laminated products. Nonstructural and semi-structural parts of aircraft, such as fairings, fillets, housings, cowlings, ducts and the like, are excellent examples of irregularly shaped objects which would be extremely difficult if not impossible to laminate at high pressures; yet because the loads they are required to carry are not particularly severe, their fabrication via low pressure methods is entirely feasible.

A differentiation must be made between low pressure and high pressure laminating with thermosetting resins. High pressure laminating of sheets, rods, tubes and molded laminated articles usually entails the pressing of impregnated and dried sheet stock material at pressures ranging 1000–2000 lb. per sq. in. and temperatures of 150–165° C. for phenolics to 130–150° C. for ureas. In the low pressure methods, on the other hand, laminating pressures of 100 lb. per sq. inch or lower (usually much lower), are employed at curing temperatures generally below the corresponding temperatures for high pressure laminating.

The use of both lower pressure and temperature in the curing cycle naturally means that new types of resins have had to be developed for these applications. From the point of view of laminating procedure at least, a liquid resin is most desirable. At the same time, the variety of applications which it may be called upon to fulfill necessitate a most versatile type of resin. In one case, a strictly cold set cure may be imperative. In another instance, only a low curing temperature may be economically possible. In still another situation, the part may best be laminated with a delayed action type of cure. The resin is also required to perform these various functions equally well at whatever laminating pressure in the low range it may be cured. Consequently, the advantage of having at our disposal certain basic resins which will perform all of these requirements with appropriate catalyst additions is obvious.

In order for a liquid resin to be used in low pressure applications, it should be carried to as high a state of condensation as possible and still be fluid enough for working. By this method, the later conversion to the cured state will liberate minimum amounts of reaction products such as water, ammonia, etc. In addition to high condensation, the resin must be stable at low temperatures while being potentially convertible at intermediate temperatures.

The usual procedure as to cure has been the addition of highly acidic substances which throw the resin over but at the same time frequently create a destructive influence on the cellulosic base material used as a laminate. Recently, however, there has been developed a series of resins which, when cured, have a nearly neutral resin in the laminate.

Ordinarily, high condensation would result in a very high viscosity or solids resin product which would be unsuitable for low pressure laminating. Then, too, the possibilities of obtaining low temperature stability would be remote with those types. The General Electric Plastics Laboratory has developed several highly successful resins suitable for low pressure laminating which do not have these drawbacks.

In addition, the low pressure technique has fostered the use of thermoplastic resins in laminated applications. Resin solutions of suitable concentration are used for coating or soaking the built-up laminae, after which the solvent is evaporated off at room or slightly elevated temperatures. For a better bonded, higher density product, the article may be given a short laminating cycle at very low pressures (3–10 lb. per sq. inch).

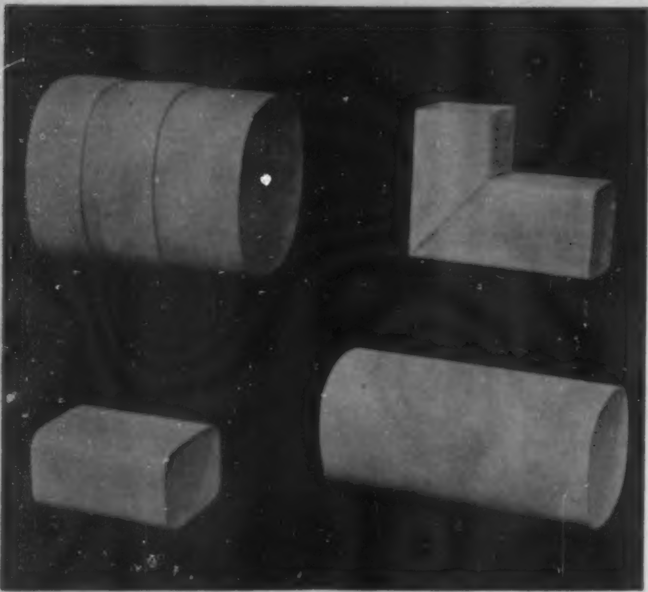
In determining the relative merits of low pressure laminating, as compared with the conventional high pressure methods, the fabrication methods which the low pressure technique employs must be studied.

Since the pressure

COMPARISON OF PROPERTIES OF LOW PRESSURE AND HIGH PRESSURE LAMINATES

1. Unless specially treated, moisture absorption is high.	1. Moisture absorption is low.
2. There is a minimum distortion, displacement, or rupturing of fibers; thus there is more effective utilization of strength values.	2. High pressure and high temperatures required in laminating process may result in damage to fibers of the laminate, thus decreasing its strength values.
3. Tensile strength is good.	3. Tensile strength is good.
4. Flexural strength is good.	4. Flexural strength is good.
5. Compressive strength about one-half that of high pressure laminates.	5. Compressive strength is high.
6. Modulus of elasticity somewhat lower than that of high pressure production.	6. Modulus of elasticity is high.
7. Toughness superior to that of high pressure product.	7. High resin content makes product less resistant to fracture.
8. Specific gravity low (1.0 to 1.2), resulting in greater resistance to bending or wrinkling per unit weight.	8. Specific gravity high (1.3 to 1.4), therefore inferior in stiffness characteristics.
9. Bonding properties somewhat poorer than those of high pressure laminates.	9. Bonding properties are excellent.

*Group leader, and staff chemist and director, respectively, of the Plastics Laboratories, General Electric Co.

1


2


3


and heat used in low pressure laminating are relatively low, the mold die or mandrel employed may be much weaker and more simple in nature, hence lower in cost and easier to construct. Then, too, most of the laminated parts fall into two categories: those capable of being fabricated on a male member and those for which a female mold is more adaptable. The other half of the mold consists of a flexible membrane or sheet by means of which hydraulic pressure, or its equivalent, may be transmitted to the article being laminated. Of course, those applications requiring no laminating pressure need no flexible membrane. Thus the practicability of using only half a mold and the relatively simple construction of the mold itself present a real saving in time and expense.

The molds themselves may be constructed of such low cost and readily available materials as wood, concrete, plaster of Paris, papier-mâché, sheet metal and crude castings from low melting alloys.

Wood makes an excellent, lightweight material for mandrel and male form work on which the impregnated laminates may be wound and subsequently cured in an oven with no additional pressure required for laminating. Those parts which have suitable draft may be wound on a solid core or mandrel. Those which have changing cross sections or no draft may be constructed on a split core or a removable core made up of several suitably shaped pieces held together with dowel pins. For a superior wooden mold, the surfaces may be treated with a thermosetting resin, cured and finished to size.

Concrete and plaster of Paris are both materials which are easily cast to shape, in addition to being capable of imparting a polished surface to the laminated article if so desired. Heating coils may be cast in the molds themselves or the mold thickness may be made as thin as possible to allow the quickest transfer of heat when placed in a curing ambient. Plaster of Paris in a thin section also has been used as a winding core for irregularly shaped objects and subsequently shattered out after the curing cycle has been completed.

Papier-mâché molds are best suited for laminating parts requiring little or no pressure. Wood pulp and a water soluble binder are intimately mixed before forming to shape and drying. After the laminating cycle, the mold is destroyed by dissolving out the binder and removing the pulp. Although it can be used only once, the low cost and ease of construction make papier-mâché a very attractive material for low pressure laminating.

Unless metal is used sparingly as a mold material, it will defeat one of the prime reasons for going to low pressure laminating—conservation of strategic raw materials. Sheet metal molds which are not too complicated to shape or required to be held to close dimensions offer a satisfactory solution for quick and efficient mold construction. In many instances, sheet metal parts which the plastic is replacing may be used for the mold itself. Low melting alloy castings, which may be melted out after laminating, are highly satisfactory where the weight of the casting will not interfere with handling. For larger size objects, sludge castings with relatively thin wall thicknesses will solve the problem.

After selection of a proper mold, based on production re-

1—*Low pressure laminates of fabrics and paper base materials are replacing metals in widely diversified war uses. There are almost no limits to the contours and shapes of cold wound laminates that may be fabricated by this method. Lower section of photograph shows fabric base cold wound laminates.* **2**—*Here is an unfinished housing laminated at 15 lb. per sq. in.* **3**—*Air duct laminated at zero pressure*

quirements, laminating cycles and mold materials available, the question arises as to the best procedure for building up the assembly prior to laminating. Since this part of the process is the most costly, largely because of the handwork involved, any saving in material and labor which may be effected through ingenious methods or production technique is highly important. In fact, it may be one of the deciding factors in determining whether it is feasible to fabricate a part by low pressure laminating.

The use of flat sheets of laminating material in the build-up wherever possible is, of course, desirable from a production standpoint. On those shapes which ordinarily could not be accommodated by a flat sheet, the choice of a more loosely woven fabric which is capable of being stretched or deformed offers a solution, if the probable lowering of strength is not objectionable. In other instances, flat sections developed from templates may more advantageously be used.

Complex curvature sections with rapidly changing contours will usually require tape, at least in some portions of the build-up. Tape is not only a convenient material for building up and holding the assembly together, but may well impart added strength characteristics. In the air duct shown in Fig. 1, a combination of canvas duck and airplane tape was laminated with gratifying results.

In general, the cloth and tape used in the build-up are dipped, sprayed or coated with resin prior to assembly on the core or mold. It is advisable to have the resin sticky at this stage, as it assists in holding the layers in place, particularly in parts with complex curvatures. After the final layer is in position, several additional coats of resin may be painted on to give a surface superior both in appearance and in resistance. An alternative method of fabrication consists in laying the untreated cloth or tape on the form first and then applying a coat of resin before putting in the next layer. Thermoplastic solutions are generally applied by the latter method, allowing suitable time for evaporation of solvent between application of each layer.

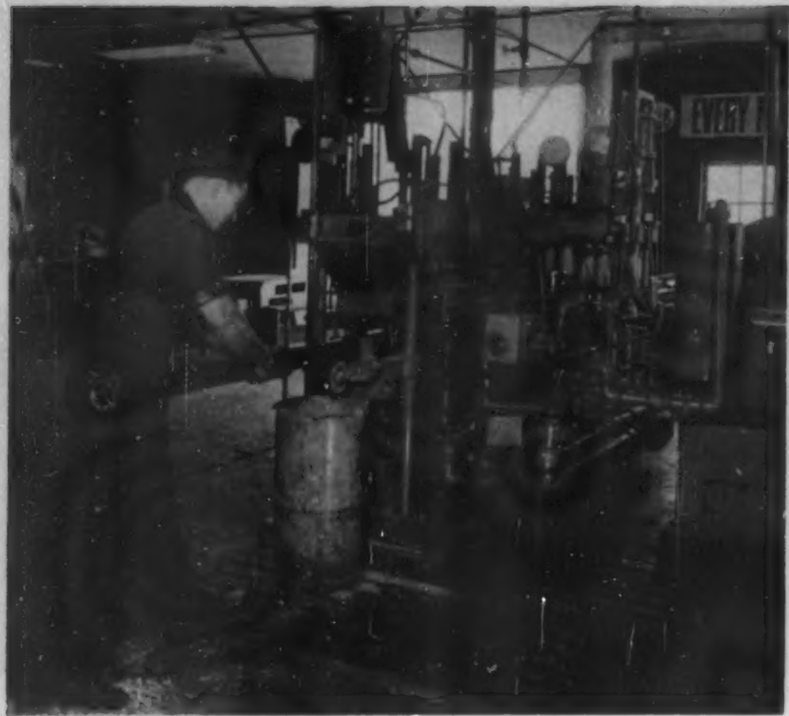
After assembly is complete, those parts requiring no additional pressure for laminating other than that derived from the tension applied to the various layers themselves are simply placed in an oven at the curing temperature desired, and shocked loose from the core after cure is complete. Those parts requiring low pressures for bonding are placed in special, inexpensive set-ups where heat for curing and hydraulic pressure for laminating are applied. A thin membrane—rubber for example—is placed between the built-up laminae and the hydraulic medium to ensure even application of pressure and suitable finish. The hydraulic pressure medium used may be steam, water, oil, air, etc. Heat for laminating may come from either side of the molding surface, from the hydraulic medium or from a separate source. On certain applications, particularly those where the curvature is slight, loose sand and lead shot have been used to considerable advantage as a source of pressure. In any event, the primary purpose is to make the curing process as fast and as simple as possible while still obtaining the desired properties in the finished article.

The wound type of low pressure laminating product is not merely another glue-bonded cold rolled tube, but a laminated plastic in the truest sense of the word, since the paper or cloth base laminates are both impregnated and bonded together with resin. A mere suggestion of the variety of shapes possible is shown in Figs. 2 and 3. Although the contours of these shells are necessarily uniform throughout their length, the possibilities of fabrication (two of which are shown in the upper portion of Fig. 3) make the number of direct applications much larger.

Simple, inexpensive wooden mandrels are used exclusively in this work. The size of mandrel is governed only by the size of tube rolling machine. With the proper selection of paper or cloth base stock in combination with recently developed semi-cold set impregnating resins, both bonding and impregnation are accomplished with the same rolling operation. The winding process takes only 3 to 4 minutes for an average-sized piece. The shells are then allowed to remain on the mandrel at room temperature and no pressure for an hour. After a final oven bake at a low (*Please turn to page 122*)

4—Synthetic resin-coated split wooden mandrel for cold wound laminates

4



1

2

1—Resin-treated laminated paper products helping to solve the metal problem as steel replacement for pipes are formed in hydraulic press. 2—For shot hole casings, this tubing is furnished in 10-ft. lengths

Priority-free pipe

by H. W. Richter*

REPLACING steel casing ordinarily used in the seismographic method of oil prospecting, a newcomer in the growing family of resin-treated laminated paper products shows considerable promise as a partial solution to the metals shortage problem.

Fedralite is the name which identifies the various combinations of fibers, Vinsol[1] resin and modifiers described in U. S. Patent 2,264,189 and in a number of pending patent applications, domestic and foreign.

Available without priorities, low in cost, light in weight, safe to handle and easy to retrieve for re-use, shot hole casing made from this material is winning its way to acceptance by the oil industry.

Method of fabrication

The tubing is made by wrapping around a mandrel a number of layers of resin-treated fiber paper produced on a cylinder board machine. The preform is transferred to a specially constructed press carrying a mold slightly over 10 ft. in length and equipped with a mandrel over which the preform is slipped (Fig. 1). Mold and mandrel are equipped for introduction and removal of steam and water. Operation of the press after introduction of the preform is entirely automatic. In $6^1/_2$ min., the finished tubing is ejected, ready for shipment save for trimming of the ends. The tubing is currently being supplied for shot hole casing in 10 ft. lengths with an outside diameter of 3 in. and with a wall thickness of $^1/_8$ in. (Fig. 2). The product is so light that a man can carry 70 ft. of 3-in. tubing on one shoulder (Fig. 3). Tubing of greater diameter can be produced by similar methods where the prospective volume is sufficient to justify the expense of the molds.

Properties

Strength and water-resistance of the new tubing are ample to meet the usual conditions encountered in oil prospecting. Supported on a $9^1/_2$ ft. span, a length of it will support the weight of two men. Samples of the product are tested in a specially designed apparatus in which hydrostatic pressure is applied to failure. The minimum "burst point" has been established as 200 p.s.i. Tubing failing at 400 p.s.i. has been produced by special methods.

Suggested applications

Among possible uses for this resin-treated fiber tubing is the construction of low-pressure oil or gasoline pipe lines. Highly resistant to petroleum products, the material would seem to have considerable promise in this field.

It should be borne in mind that the resin-treated fiber material is not an overall replacement for phenolic and other laminates that have served so well in many fields. Someone has recently very aptly characterized it as the "valuable missing link between hard fiber and the phenolic resin products." Proposed uses should be carefully studied. With

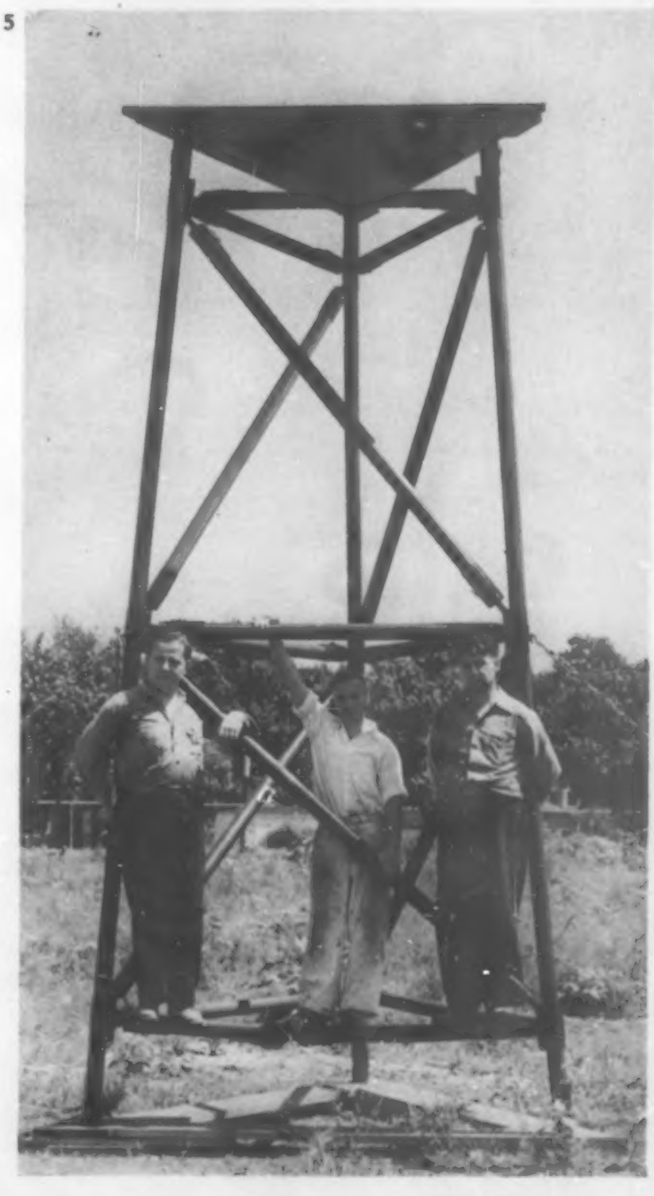
* Consultant, Federal Electric Co.
[1] See MODERN PLASTICS, June 1942, page 59.

3

4

3—Sturdy, water-resistant and lightweight, 70 ft. of 3-in. diameter tubing can be balanced jauntily on a man's shoulder. 4—Close-up of jointed attachment shows laminated tubing secured in adjustable metal sleeves in a simple swivel joining. 5—Tank tower constructed of resin-treated fiber tubing. Note that it can support the weight of three men

5



due regard to the limitations of the material as well as to its strong points, it should be possible to adapt it to many uses in which requirements are not so severe as to call for the ultimate in physical properties. Its successful manufacture and use as shot hole casing well illustrate this point. Intelligently used, the material can replace steel and other scarce metals in many categories and should, therefore, prove of real worth in the present emergency and thereafter.

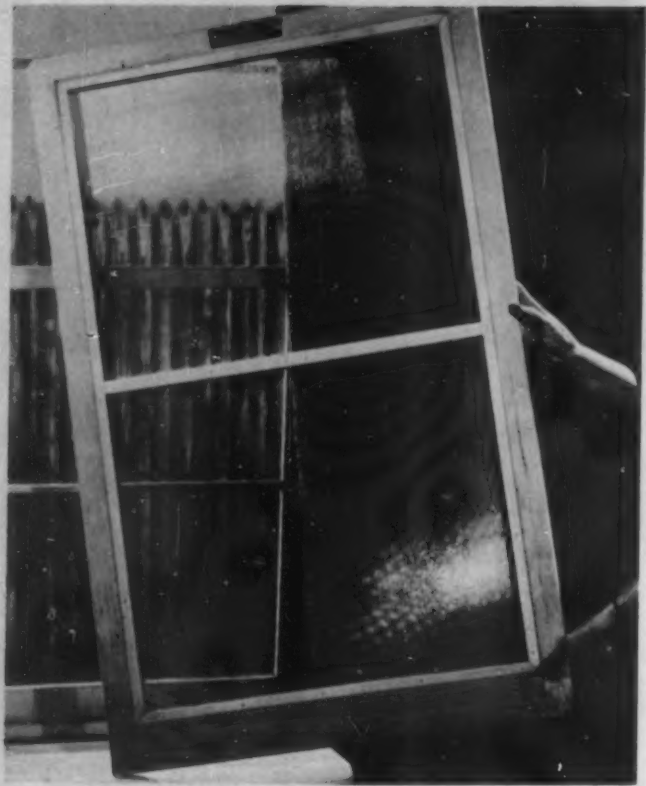
Credit—Material: Fedralite, by Gillette Fibre Co.

TABLE I.—LAMINATED FEDRALITE PROPERTIES

For sheet composed of approximately 50% fiber and 50% resin

Specific gravity	1.25 to 1.35
Weight, per sq. ft. $^1/_8$ in. thick	0.9 lb. to 1 lb.
Softening temperature	225° F. (approx.)
Water absorption, 24 hr., percent	
Sample: $1 \times 3 \times {}^1/_8$ in.	2.8 to 4
Modulus of rupture	
$^1/_2$-in. bars	12,500 to 19,500
Tensile strength, p.s.i.	9000 to 12,000
Compressive strength, p.s.i.	
Specimen: Cross sectional area 2.96 sq. in.	10,000
Double shear, p.s.i.	
Specimen: 0.750 in. diam.	6500 to 9100
Punching qualities	Excellent
Brittleness	No tendency (extremely tough)
Dielectric strength, volts per mil	350 to 500
Elasticity	Good drawing quality
Machines	Readily

NOTE: The above tests are approximate and subject to revision, as machine production thus far has not been standardized.



Insect screen

Boon to home owners, bane of insects, this new plastic screen is weatherproof, colorfast, tough and handsome. Woven of extruded fibers of vinylidene chloride resin .010 to .011 in. in diameter, the screen may be fabricated in standard widths and meshes on either wire or fabric looms. Aside from the present importance of this new screen as a metal replacement, there are numerous other advantages claimed for the material. It is reported to have extraordinarily high tensile strength (about 50,000 lb. per square in., equal to that of mild steel), and to be sufficiently flexible to withstand almost any mechanical injury except cutting or burning. It is said to be resistant to sulfur fumes from coal smoke, to the salt air of sea coasts and to alkali present in arid areas. Two years of rigorous testing are reported to have demonstrated that neither sun nor salt nor air will cause rust, corrosion, mold or oxidation of the material. And even gasoline, oil, ordinary solvents and chemicals are ineffectual enemies of this new plastic screen.

It is suggested that this screen will be highly suitable for use in the tropics as tent vents or flaps, or as a helmet hood to ward off insects. Most screens deteriorate within a year in the tropics because of the intense heat and atmospheric conditions.

Credits—Material: Saran. Permalon screen manufactured by Pierce Plastics, Inc.

PRODUCT DEVELOPMENT

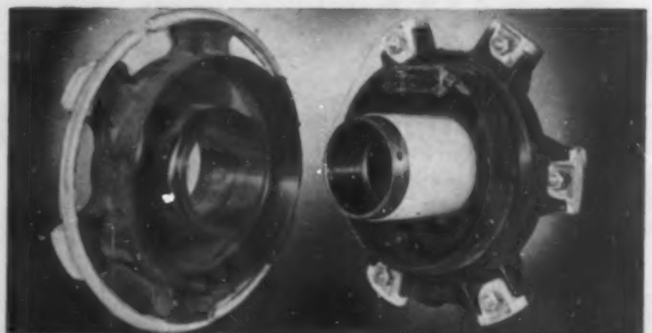
Differential wheel bearing

In these days of rubber tire scarcity the differential wheel, described as an aid to extending tire life, assumes new importance. Improved bearing action for differential dual wheels has been achieved by use of laminated phenolic plastic for inter-wheel bushings which have a load-carrying capacity of several thousand pounds per square inch. The advantage of this bushing, which is machined from tube stock, is that it has successfully eliminated the human element, because once installed it requires no lubrication.

The function of the plastic bushing or plain bearing (see section in light color on inner wheel hub, at right), is to provide inter-hub bearing surfaces for the action of differential dual wheels. In order to provide the necessary differential action between two dual tires, and to facilitate their rolling freely on roadbeds without scuffing or slipping, wheels must be inter-mounted in telescopic relation at the hub. The laminated bushing is the bearing surface between hubs.

The outer wheel assembly (left), rotating on the hub of the inner wheel, is a slow moving part, averaging only a few revolutions per minute on the inner wheel hub under average operating conditions. The inner thrust washers (lower photo) for the wheels are made from fabric base plate stock, with a graphite inclusion.

Credits—Material: Synthane. Manufactured by Differential Wheel Corp.



PRODUCT DEVELOPMENT

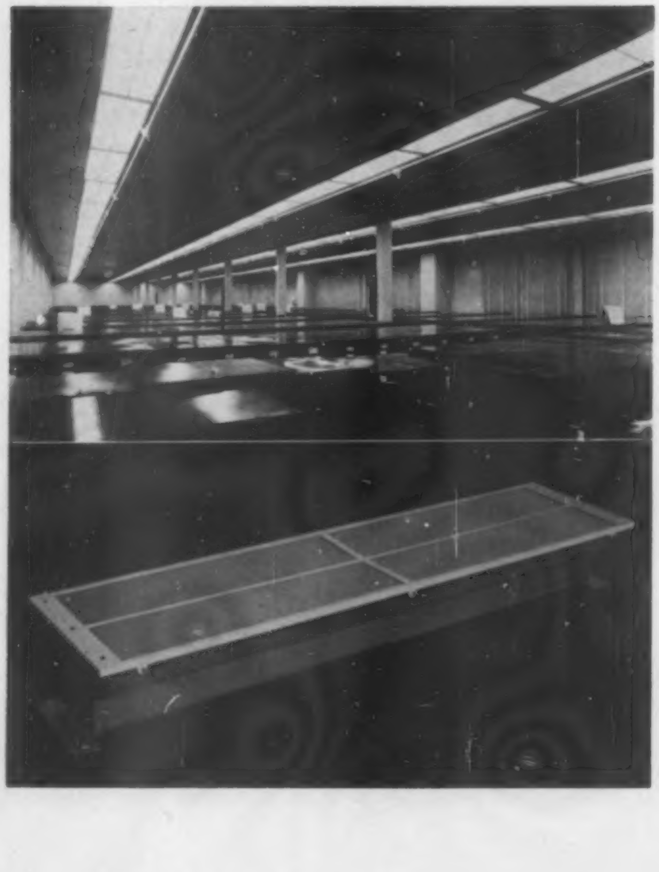
Industrial safety suit

Superman's daring, contempt of danger and immunity to hazards may now be assumed by a worker who wears a plastic Skullgard and an asbestos coverall. Resistant to fire, explosions, chemicals, this one-piece suit consists of an upper and lower garment securely sewed together, with gloves, boots and a plastic reinforced helmet attached, so that the wearer is completely enclosed and protected from flame, insulated from heat and guarded from injury.

The helmet of the suit is of canvas, impregnated with phenolic laminating varnish and molded to form in one piece. The strong, smooth plastic is described as fracture-resistant, a non-conductor of electricity, and as immune to water, oil or perspiration. The crown of the hat is reinforced with a wire screen which adds to the great inherent strength of the lightweight laminated phenolic plastic. These headguards resist impact of falling objects, blows and bumps. They are covered with an asbestos hood, and secured with front and rear aprons for maximum head and neck protection. Unobstructed vision is provided by a large heat-resistant glass window set into the hood.

The wearer climbs into his suit through a zipper opening which extends down the front to the waist.

Credits—Helmet material: Bakelite. Manufactured by Mine Safety Appliances Co.



Vision for victory

Shields of louvered, laminated cellulose acetate plastic eliminate glare from fluorescent lighting and reduce brightness to the level of maximum eye comfort and vision efficiency. One of the largest installations of fixtures employing this material was made recently at Bolling Field (above).

The pliable, lightweight, shatterproof material is manufactured in sheets approximately 20 in. wide and 50 in. long, in three thicknesses—.040 in., .060 in. and .080 in.—with tolerances held to plus or minus .010 in. The white louvers are approximately .003 in. wide, running the 20 in. way of the sheet and extending through the thickness. They are perpendicular to the sheet surface with a tolerance of 10°, and spaced .040 in. apart. Transparent spacings between louvers are water-white plastic.

The material is available in two types of surface finish—polished or prism. The prism type, which was used in this installation, has 40 refracting prisms per inch embossed upon one surface, the prisms running the length or 50 in. way of the sheet at right angles to the louvers. The action of the prisms is to spread the brightness of the lamps and reduce reflected glare from the work, thus improving visibility.

This installation is described as having been entirely satisfactory, with no perceptible warping or shrinking.

Credits—Material: Louverplas. Fixtures by Sylvania Electric Products, Inc.

OFFICIAL PHOTOGRAPH, U. S. ARMY AIR FORCE

1—*Swift and silent, these gliders take off on a motorless flight. At about 4000 ft., they will be released from tow line*

Hot wings and cold set resins

THE fall of Crete last year focussed the attention of General Staffs in every country on the possibilities latent in a daring aerial weapon—the glider train. The newest and hottest development in this field is the use of plastic plywood in gliders.

Based on the fundamental principle that an airplane (like a truck or a locomotive) can tow more than it can carry, the use of gliders to carry troops and equipment over difficult terrain or wide stretches of water to points otherwise inaccessible is a logical development in the use of this type of craft. Not only are the gliders more maneuverable for landing troops than parachutes dropped from planes, but they use less critical materials, are produced more rapidly and are less expensive than huge transport planes.

For some time now, the Armed Services have been experimenting with troop and freight-carrying gliders, and on July 17 Lieutenant General H. H. Arnold announced the formation of a new air unit to be known as the "Troop Carrier Command." Tactical training of Army air-borne combat teams, using large gliders and transport planes for lightening offensive action, is already in progress. Calling for more volunteers to train as glider pilots, General Arnold predicted that the troop carrier command, all of whose soldiers, equipment and supplies will be carried by air, would receive high recognition for important missions.

Gliders are not new. Man has been toying with the idea of bird flight since the disastrous experiment of the mythical character, Icarus. Leonardo da Vinci built a glider, and small boys the world over have tried to glide from the roofs of their barns into the untracked sky. Gliders are exciting because they are closest to the actual flight of a bird.

The biggest problem in airplane construction is the weight: strength ratio. Next, the engineer must figure the amount of horsepower he can cram into a small, light structure to produce a ship that is fast, maneuverable and easy to fly. The builder of a glider has no such calculations to make, though, of course, considerable engineering is necessary. A glider can take off with little external mechanical aid, and can stay aloft indefinitely under its own lift by taking advantage of wind currents.

The new application of gliders makes them cars in a train, with the airplane serving as the locomotive. Each glider will hold 9 or 15 men, or food or clothing or ammunition or whatever the logistic requirements of a given attack involve. Because a glider has a low landing speed, it can land practically anywhere—on a road, in a field, or even in a treetop if necessary. In modern practice, gliders can be taken in tow by an airplane in flight just as sacks of mail are picked up. This new technique also makes it possible for gliders to be hoisted from the ground and towed back after they have landed their troops. Gliders are, of course, silent, and this is a great advantage when troops are landed by air.

To these inherent properties and possibilities, gliders now add strength and light weight by virtue of the plastic-bonded plywood which composes them. These almost-lighter-than-air craft were formerly made of chrome alloy, steel tubing and airplane cloth, but because of increased production schedules and a desire to avoid using strategic materials, both the Army and the Navy have turned to plastic plywood. Plastic-bonded plywood is used in wings, tail and rudder, though fuselages are still made of steel tubing because speed was demanded in development and construction, and the amount of time necessary for designing a wood fuselage would have delayed the adoption of gliders as a factor in immediate offensive warfare.

One basic training glider is a two-place affair, developed

2

3 PHOTOS, PRESS ASSOCIATION, INC.

2—Fully armed and ready for action, these infantrymen board nine-place Waco glider for a demonstration flight. This model carries a full squad of eight men, in addition to the pilot. 3—Clutching their rifles, bayonets fixed, these airborne troops leap from their gliders fully prepared to charge against an imaginary foe. These plastic bonded plywood ships are light, strong and longlived

from designs made by the Schweizer brothers, founders of Schweizer Aircraft Co. The Schweizers are two young men with the glider bug. The glider they built performed so successfully at a demonstration before Army and Navy officials last year that it was selected by both Services as the basic design for a training ship.

The leading edges of the wing, the tail, the rudder, the ailerons and the spoilers (which are a kind of "air brake" for reducing the ship's speed in mid-air) of the Schweizer glider are all made of plastic plywood, airplane type, and some plain wood. Since production is still in its early stages, the molding possibilities of plywood have not fully been taken advantage of. Some parts are molded by the plywood manufacturers to order for the Schweizers. Plastic plywood is selected, naturally, because of its great strength, its weather- and water-resistance, its long life and its light weight.

Around the leading edges of the wings, plywood in thicknesses of $^1/_8$ in., $^3/_{32}$ in. and $^1/_{10}$ in. is used, the thicker plies toward the base of the wing, where the greatest stress is applied in flight. The thinner wood is used toward the outer edges of the wing. This is heavier wood and is cut to shape. The skin wood is bent to form by being first wet, while heavy weights on metal straps are placed over it along a metal pipe. Then it is steamed in a trough. A curve approximating that of the leading edge of the wing is achieved by this method and the plywood is then further curved and glued into place over the ribs, where it fits perfectly. Plywood is also used to reinforce the ends of the wing spars, where bolts for fastening are attached. The wings are detachable from the ship and from each other. Plywood is used in wing construction for its resistance to cracking and its ability to hold the heavy metal bolts used to attach the wings to each other. Most gliders are built with detachable wings for easy shipping and storage.

Plywood gussets are used on the individual ribs and are set into place with a cold set urea resin adhesive. The ailerons are of similar construction, although there is no curve of the wood. Flat sets are joined along the pointed edge with nails. Plastics are also used in the form of cellulose acetate and cellulose nitrate sheeting for the transparent cover of the cockpit. Laminates are used as guide pulleys for the control wires. In some cases a molded phenolic wheel is used on the tail. The entire wing is covered with cloth, as is the fuselage, and then sprayed with airplane dope. Preliminary models have passed flight tests and are now in production in many plants throughout the country.

Other types of glider—9-place and 15-place—have been developed and are now being manufactured by Waco Aircraft Co., Cessna Aircraft Co. and others for actual use in maneuvers and presumably in combat. One basic reason for selecting the design and the material (both of which involve plastic-plywood) for these Waco ships was the desire of the Army to achieve a simple manufacturing process so that contracts could be let not only to experienced aircraft companies but to furniture and boat manufacturers as well—requirements which the Waco ship meets. The use of plastic-plywood for airplanes is not new to Waco, and their Model-E ship has long used the material. The company is also experienced in working with plain, unlaminated wood.

In the Waco gliders the entire wing is made of wood, including a hollow plywood spar, and a complete skin of plywood tapering from $^3/_{32}$ in. to $^1/_{16}$ in. thick. Since large-scale production is only beginning, many manufacturing processes

will undoubtedly be changed. At present, for instance, the plywood skin is merely glued with a cold set casein adhesive (although heat is applied locally to speed the set), first being held in place and under the proper pressure with a pre-set nailing device. Nails are driven in only part way through an overlayer of wood which is stripped away after the adhesive sets, and the nails then driven in to their full depth. Waco bonds its own plywood for certain applications. Several heavy layers of walnut and soft woods are glued together to give bolting bearing at a joint. Access openings in the wings are made of somewhat thicker plywood which is cut and glued in the Waco shops.

An interesting technique used by the company to give additional torsional strength to the plywood skin is to glue the plywood sheets on the bias at 45° angles so that the grain runs obliquely to the direction of flight. The sheets are lapped, glued and nailed on in sections, about a dozen to each wing. As the process is developed, it is expected that they will be entirely glued. All of the tail parts are also made of plastic-plywood, and are similarly constructed. The fuselages of the Waco ships, like those of the Schweizer trainers, are made of metal because too much time would be required for experimentation and design before a plywood fuselage could be developed. It is anticipated that eventually the entire ship will be made of wood.

The use of plywood in glider manufacture has enabled Waco to employ women workers in their plant. Women are able to perform many of the gluing operations which take the place of welding in metal ships, and are skillful in placing the struts and cross members which form the ribs in the jigs.

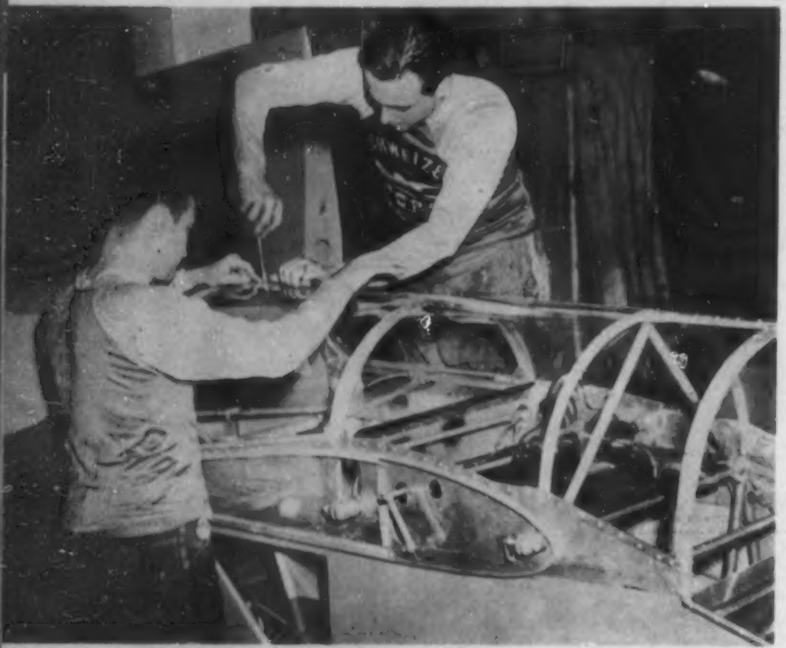
In the Waco plant, a hot press similar to a laminating press has been added to the production room. When this press is put in operation, it will turn out resin-bonded ribs with plywood gussets at a rate of 8 per cycle. The ribs, completely set up in metal jigs, will be fed into one side of the press and taken out the other. This will greatly speed up production of ribs, which are now made by hand only. In the hand operation, metal jigs are not used. Mineralite boards with wooden blocks nailed into place form the basis of the present jigs.

Of the use of plastic-plywood by Waco, Engineer M. P. Baker says: "We prefer wood because it is lighter and stronger than metal. Now that the plastic-bonded plywood has given us the necessary weather resistance, we can indulge our desire to use this ideal construction material on all of our ships."

In the application of cellulose acetate and cellulose nitrate sheeting to the cockpit enclosures, and to the portholes, Schweizer uses a simple curve, bending the material around aluminum ribs and holding the plastic sheet in place with crosshead screws. Waco, on the other hand, has a more difficult curve problem, and finds it necessary to mold the sheeting in a hot oil bath before applying it to the frame of the cockpit enclosure.

Plastics are used in gliders in many other applications which parallel those of motored ships and for the same reasons of strength and light weight. Many of these plastic parts were used because of their efficiency and economy of installation even before metals became scarce. Such parts as control

4



PHOTOS, COURTESY CELANESE CELLULOID CORP.

5

4—Workmen attach cellulose acetate cockpit enclosures to one of the new gliders for use by our armed forces. 5—Nose section of a training glider shows the extensive use of transparent plastics on these Taylorcraft training ships

knobs and joy stick grips are injection molded of cellulose acetate and the instruction and nameplates will probably in future be made of some plastic material. To keep weight down, radio and other communications equipment is largely of cellulose acetate and phenolic material. These parts include insulation, earphones, buttons, dials, instrument cases, etc. In many batteries, cellulose nitrate or cellulose acetate butyrate cells are used. Many ships utilize plastic (usually cellulose nitrate) grommets around openings for draining off condensation from wing interiors, and for reinforcing around the openings for cables that operate ailerons, elevators and rudder.

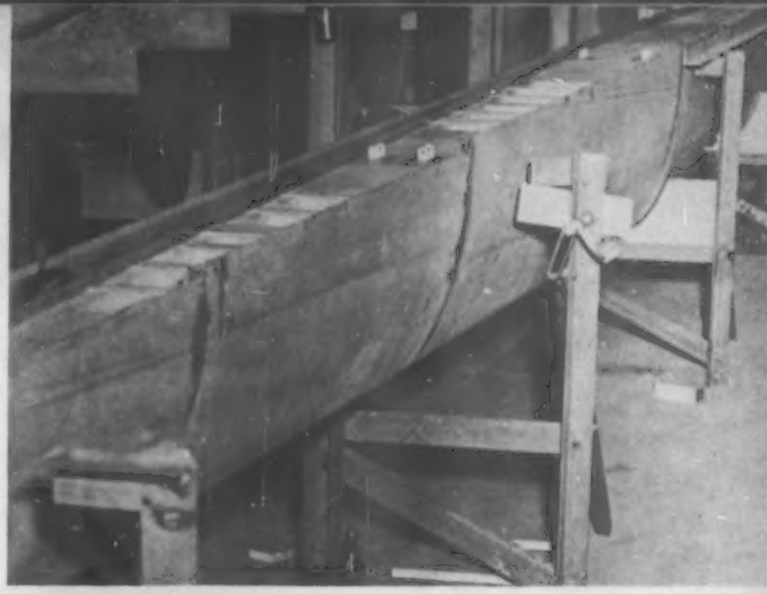
All of the designs allow wide visibility for pilot, observer and navigator. The cockpits are enclosed in cellulose acetate from the knees of the pilot to well in back of the tandem seat, and some have windows in the floor slope so that the pilot can see the ground. The multiple-place ships have portholes in each side to admit light. These window and cockpit enclosures are formed of cellulose acetate, but only the rear and forward cockpit sections require heating for the forming operation because they have the only compound curves.

Each ship has one or more sliding observation panels which are fitted into side windows since, in the interest of economy, windows and cockpits are stationary and cannot be moved. Cellulose acetate and nitrate inspection rings and plates are spotted throughout the ship at strategic points in insulation, communication, key wiring, or where inspection of stressed members is necessary so that repair and inspection can be made without dismantling the ship. The ring is cemented to the taut wing fabric, an area equal to the inside diameter of the ring is removed, and a transparent cellulose acetate or cellulose nitrate plate fitted with lugs is snapped into place. The plates are easily removed with a screwdriver or any similar prying implement.

The dope which is used on airplane fabric as a paint base is made of cellulose nitrate. Glider wings fabrics have been impregnated with this doping agent because it has been found to have excellent sealing and stretching possibilities, giving the necessary lift to the fabric. The less flammable cellulose acetate butyrate is also used in this application, although this factor is somewhat less important in gliders than in powered planes, since gliders do not offer the comparable hazards of fuel or engine exhaust. The method of application is simple: Two coats of clear dope are first brushed on, then sanded and two more coats of clear dope sprayed on the fabric. Pigmented coats are then applied.

The new developments in airplane constructions are tending more and more to the use of plastic-plywood and plastic resins principally because of their lightweight construction and great strength. From the experiments at Schweizer and Waco, and the many plants which are now building the ships developed by these two companies, a definite surge toward the use of plastic-plywood airplanes may be discerned.

6



7

8

9

6—Resin-bonded plywood forms important structural parts of one type of two-place training glider. Here complete leading edge of wing has plywood already nailed and glued into place. 7—Operator wets plywood, bent to shape over iron pipe by means of weights hung on galvanized straps. This will be steamed to give it a more prominent curve. 8—Plywood covered rudder in foreground, aileron frame with plywood gussets in background. 9—Plywood skin, $\frac{3}{32}$ in. thick, tacked and glued in placed over wing's leading edge

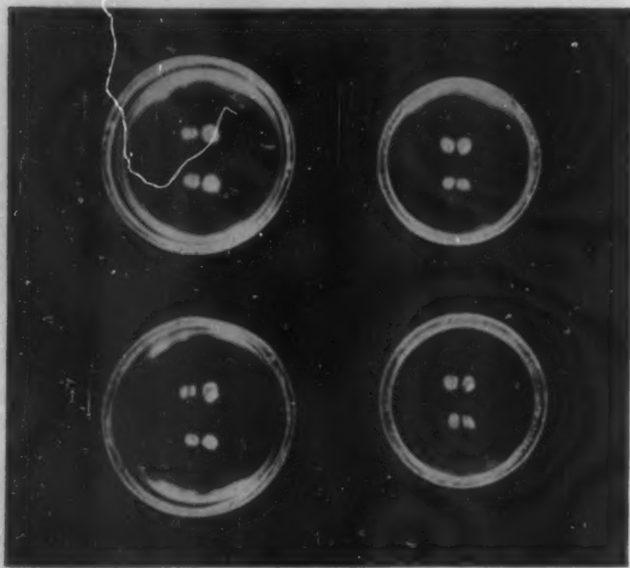
PHOTOS, COURTESY SCHWEIZER AIRCRAFT CO.

Methacrylate resins in surgery

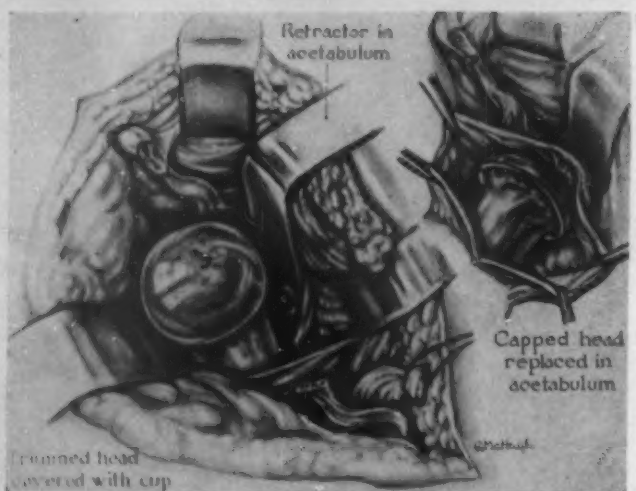
by PAUL H. HARMON, Ph.D., M.D.*

With special reference to the reconstruction of arthritic joints

1



2



PHOTOS, COURTESY ROBERT PACKER HOSPITAL

THE demonstration by Bellas[1] that a new synthetic plastic polymeric surgical suture, available in various sized strands, was well tolerated in human tissues, opened the field for the application and use of larger pieces of solid plastic in surgery. Prior to this time the use of methyl methacrylate for external surgical splints had come to our attention, but so far as we can learn, only one author (Smith-Peterson[2]) had buried a large piece of plastic within the human body with the aim of permanency. This author reported that a molded phenolic hip cup which he had employed as a mold in an arthritic hip had remained in place for two years without evident irritation.

For some time prior to this, we had entertained the possibility that if a suitable non-reacting, non-metallic substance could be found which in itself was transparent to the roentgen ray (x-ray), this substance would find wide application in surgery. At about this time the human body tissue tolerances, especially that of bone, to vitallium, a non-ferrous alloy of chromium, cobalt and molybdenum, and to the chrome-nickel series of "stainless steels" were being demonstrated, and several authors had reported upon the use of the former to reline the hip joint in chronic arthritis of that portion of the body. These metallic cups, however, have the positive disadvantage of being opaque to the roentgen ray, so that the surgeon cannot visualize bone structure within the cup. He thus lacks data to explain why certain of these operations do not turn out well, as occurs in a definite percentage. Others have held that the surface hardness of the metals has been responsible for pain following operation, a result that likewise occurs in a certain number of cases.

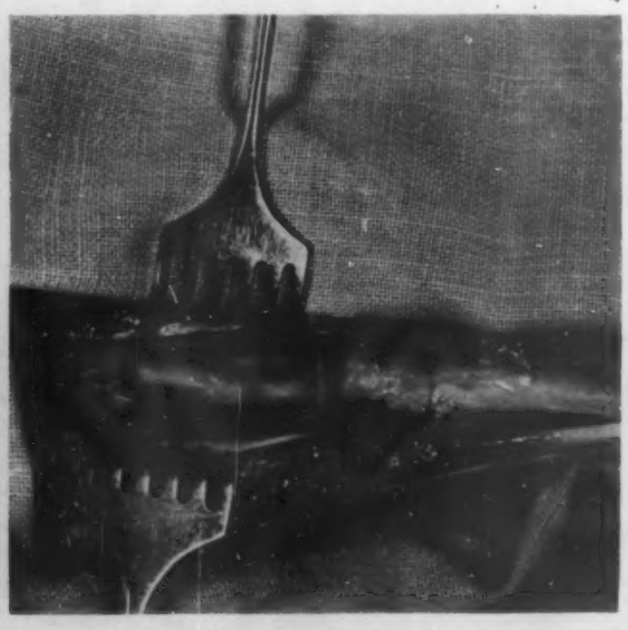
In 1940, we had the first hip cup manufactured to our

* Chief, Section on Orthopaedic and Traumatic Surgery, Guthrie Clinic and the Robert Packer Hospital, Sayre, Pennsylvania.

† John P. Croasdale, of Croasdale and deAngelis, plastics fabricators, has been associated with the author and has supplied technical aid from the standpoint of the plastics manufacturers. We have together worked out the dimensions and specifications of the other plastic appliances described in this paper. I wish to acknowledge his aid in these developments.

3

4



specifications† (see Fig. 1) and shortly thereafter performed the first operation upon the hip of a patient who had been suffering for years from a chronically painful and disabling arthritis of one hip. An account of the case and of the operation follows:

L. S., male, 62 years, suffered from pain in the hip for twelve years. During the year preceding his entrance to the Guthrie clinic and the Robert Packer Hospital, he had almost constant pain in the left hip and leg and was so disabled that he could walk less than a half block at a time. Examination of the hip showed only about one-fifth the normal range of motion there. The hip was opened at operation on October 9, 1940, at which time the head of the femur was reduced in size and was capped with a methacrylate cup. The patient's postoperative course was ideal. When he became active, following the usual postoperative exercises, he gradually extended his activity so that during the past year he has been able to walk two to five miles without fatigue. Examination of this hip shows that he now has about two-thirds normal motion in the left hip. From a surgical point of view, this is considered an almost ideal result.

So successful was this first case that we had the opportunity to perform it for other types of hip joint arthritis, 35 times on 27 patients, during the 18 months following the first case. There have been some disappointments in the results occasioned by the finding that elderly persons, those weakened by prolonged disease and those who could not fully cooperate with the postoperative regimen of exercises did not obtain the best results. However, all these patients have been benefited to some extent. Our results, recently reported [3, 4] summarizing and describing the one year end-results from the hip plastic operation in patients with osteoarthritis of the hip (the chronic deforming hip arthritis of middle and early old age) have been the best obtained in any type of arthritis. Judged by rather rigid criteria which demand at least a 50 percent increase in motion and full or almost complete relief from pain, 80 percent of 16 operated hips secured "good" or "excellent" results in this condition. The full reports of this series have been prepared for publication in medical journals and will not be summarized in full here. However, a general summary of the operation, the after-care and results will be given since we have explored this field more thoroughly than any other in applying plastics to the surgical field.

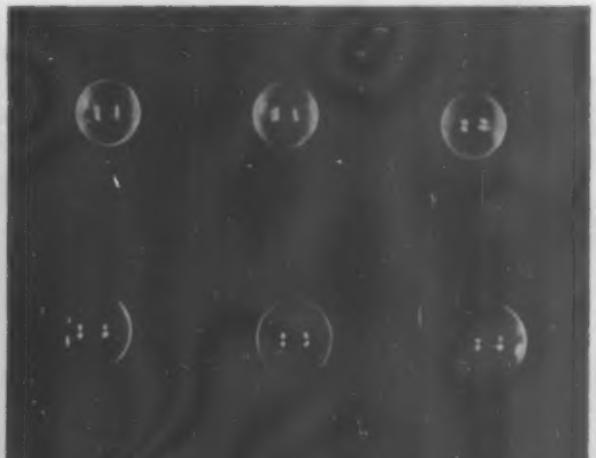
The operation (hip arthroplasty) is technically one of the difficult procedures of orthopaedic (bone and joint) surgery, and should be done only by a surgeon thoroughly familiar with this field. Any patient presenting the proper medical indications may have the operation with impunity and there should be no mortality from it. The preoperative conditions that must be met are that the patient be in reasonably good general health so that he may have a general or spinal anesthetic, and must be physically and mentally cooperative so that the routine of postoperative exercises may be undertaken with enthusiasm and expectation. The inability or unwillingness of the patient to carry out the full 3- to 7-week program of exercises following the operation has been the cause for failure in our few unsuccessful cases. The operative technique in these cases is illustrated in the views of the exposed joint in Fig. 2. Following the operation, the limb on which the procedure has been carried out is suspended in an apparatus used in carrying out postoperative exercises. Even from the first and second days following operation, these patients volunteer the information that all their old pain is gone and they are able to use the affected limb fully and exercise it with the aid of apparatus. The apparatus is worn for $2^1/_2$ or 3 weeks following the operation, after which the patient is allowed out of bed, though his activity is regulated for the ensuing 2 weeks. However, during those 2 weeks and subsequently the patient is given a routine of exercises designed to restore motion to the diseased and operated hip. Six weeks following operation he begins to use crutches and about 3 or 4 months following the operation crutches may be discarded. When both hips are involved, a slightly longer period of convalescence is required.

The operation itself is a plastic (*Please turn to page 114*)

1—Methyl methacrylate hip cups have stainless steel rings embedded in their margins so that surgeon may orient himself by x-ray after operation. 2—Plastic cup is fitted over trimmed head of femoral bone, which is then replaced in hip socket. 3—Head of femoral bone a year after capping. Its smoothness is due to fibrocartilage which has grown over it. 4—Metal plate formerly used to hold bone transplant in place is replaced by methacrylate tube. 5—Types of methacrylate plate used in certain cases of hip fracture. 6—Spheres of the same plastic fill the orbital cavity left by removal of eye contents

5

6



PLASTICS

1 A stippled glass float with a strong phenolic coupling is offered by Sears, Roebuck and Co. to replace copper toilet tank floats. Molded by Plano Molding Co. of Durez, the plastic cap, designed so that the threads are molded in, is unaffected by immersion in water, will not swell, crack or corrode

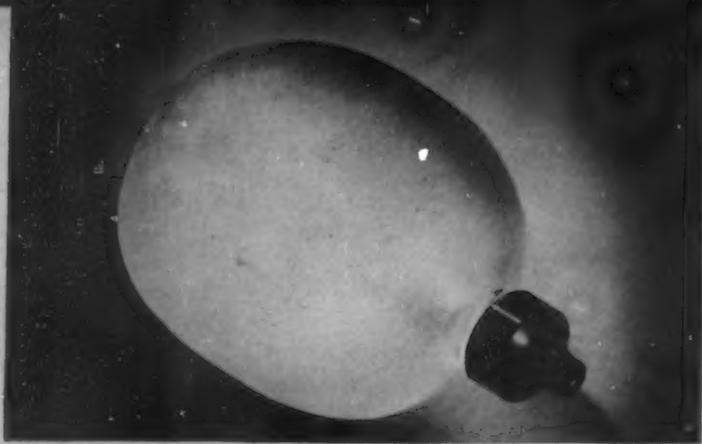
2 Extruded shapes of vinyl plastics are replacing rubber in a variety of applications where shock- and abrasion-resistance are important properties. Here a vibration-proof channel is being snugly fitted over glass. L-shaped sections are functioning as cushions on the fuselage of planes wherever metal parts meet. Other shapes are being used as shock absorbers around telephone and other instrument bases. Extruded by Irvington Varnish & Insulator Co., these items are having increased currency in these days of rubber shortages

3 Molded plastic base of Durez meets Hygrade Sylvania radio tubes' requirements for low power factor and high dielectric fatigue and breakdown. The base in center is just as it comes from the molder, Norton Laboratories. Prongs are added as a sub-assembly operation, and the final assembly is shown in the finished tube

4 The shortage of tin cans and the necessity for using bulk lubricating oils have resulted in the use of glass jars equipped with plastic spouts. Molded of Tenite by Plastic Engineering, Inc., in a 2-cavity mold, the plastic spouts are easily cleaned, and are made in colors to identify different grades of oils. Thimble shaped dust cap fitted over spout keeps oil clean. Ingenious housewives have adopted this spout for pouring sugar, salt and other kitchen stores

5 A lightweight, transparent closure of Lumarith, $^{1}/_{100}$ in. thick, replaces a fragile and heavy glass window in a large oil tank gage. Manufactured by the Pneumercator Co., the instrument is 24 in. long and 4 in. wide

6 Barrier against germs and condensed moisture is this new milk can filling unit, with a sanitary transparent cover molded of Lucite by Chicago Molded Products Corp. and marketed by

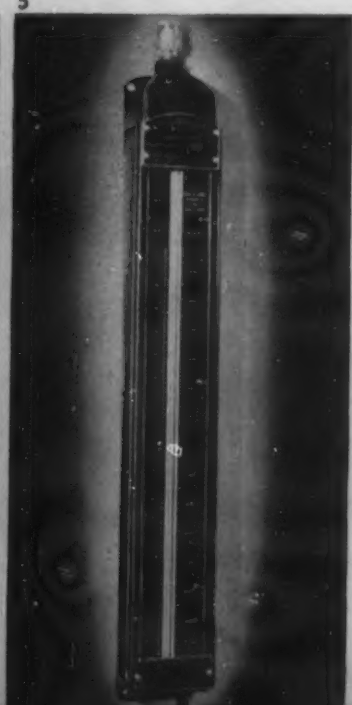

1


2


3

4

5



6

IN REVIEW

Mojonnier Bros. Practically unbreakable, the plastic cover completely seals the mouth of the can, but permits the dairyman to see the level of the milk without exposing it to the air. Designed to drain condensed moisture from the feed line to outside of can, the unit has valved feed tube built snugly into the cover to carry milk directly from feed line into the can

7 Science and plastics working together produced this Exactron instrument capable of measuring small electrical voltages. Bakelite was used for the self-insulating supporting disks, molded by the Multi-Products Tool Co., because of its extremely high volume resistivity and surface resistivity, its water and moisture resistance, dimensional stability and ease of moldability around inserts. The instrument is described as having great promise for measuring the minute currents produced by ionization chambers placed in the path of x-rays in x-ray therapy. It is based on the principles of the electrostatic generating voltmeter

8 Two-tone, two-piece Tenite strainer is provided with colored interchangeable bowls—one with fine, one with coarse perforations—to be inserted in the handle. The 96 holes in the bowl, distributed in a radius of about 2 in., are produced in the die, which was constructed to allow free flow of molding powder without clogging. Molded by Commonwealth Plastic Co. for American Strainer Corp.

9 Durable and shock-resistant cast resin provides a smooth surface for plane and tank knobs and buttons. The large knob at left is used as a gear shift knob for tanks. The smaller knob with insert is the joystick and firing button used in certain types of airplanes. These items are manufactured from Marblette rod stock by Ace Plastic Novelty Co.

10 As the plane soars aloft and moisture condenses on windshield and cockpit closures, the pilot reaches into a conveniently located box for a tissue to wipe away the mist. Molded by Plastex Corp. of Fibestos and Nixonite based on Hercules cellulose acetate flake, the container is a 2-piece unit which weighs just about half as much as aluminum, is easily attached and won't splinter into shrapnel in case of accident

7

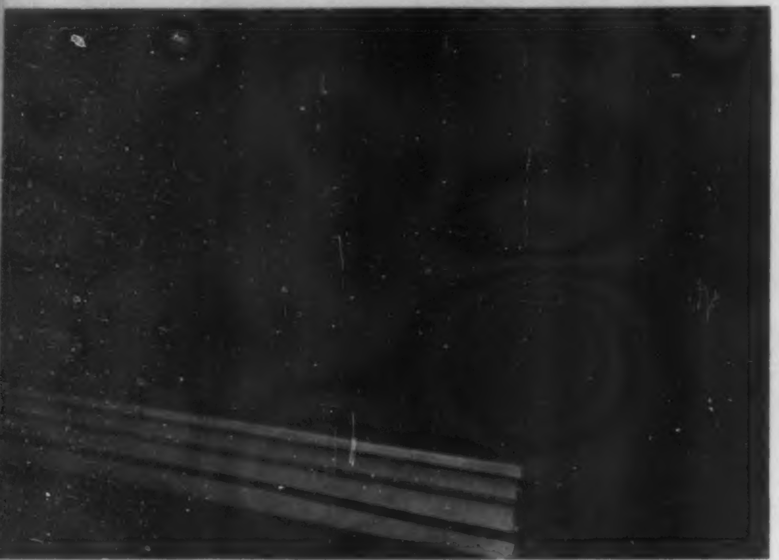
8

9

10

Dimout—visibility unlimited

PHOTOS, COURTESY CELANESE CELLULOID CORP



LIGHT, traditional symbol of good cheer and welcome, of friendship and fellowship, has suddenly, all over the world, become a potential evil. Today the "lume," or glow in the sky above a brilliantly lighted coastal city, forms a luminous backdrop against which our ships are silhouetted, targets for enemy torpedoes. So throughout the coastal cities of America, the order is "Dim out." And on the heels of that dictum comes word of a new plastic development—a blue pigmented cellulose acetate material which has been skilfully adapted for dimming out lighted show windows in coastal and other strategic areas. Originally developed in a golden amber color for the purpose of lining commercial show windows, this material was used to protect displayed merchandise from the ravages of the sun's penetrating rays.

Modified to meet the current emergency, this transparent cellulose acetate screen is now produced in a deep blue, making possible adequate illumination of shoreline shops both night and day, without hazard to coastal shipping. Many show windows, because of the sharp reflection of plate glass, must be brightly lighted both day and night for most effective dramatization of the merchandise displayed. Therefore the acetate sheet is fitted into specially designed holders which roll up out of sight during the day, and which can be pulled down and fastened into place quickly and easily at nightfall without dimming window lights.

The effect of the material is to absorb the glare, despite the undiminished brilliance of interior lighting, so that the merchandise exhibited is still clearly visible to passersby and potential customers. The impression of gloom, or the unprofitable suggestion of being "closed for the night" is entirely dissipated with this new method of dimming out. This same material is also being converted into fluorescent fixture covers for stores where the entire screen would not be practical.

Light meter recordings are reported to demonstrate that the use of this material reduces the glow about 80 percent, which more than conforms to the recent Government directive ordering the glare reduced by 75 percent as a measure of protection for coastal shipping.

The three photographs on this page graphically illustrate the effect of dimming out with this new material. Figure 1 shows a shop window with the lights completely extinguished, giving the impression that the store is closed. Figure 2 shows the shop window lighted, with the full glare of the lights reflected on the boardwalk and contributing to the out-to-sea glow which has been fatal to so many of our ships. Figure 3 shows the effect of dimming out with the new cellulose acetate material. Note that no detail of the merchandise in the window is lost or blurred, but the glare has disappeared.

Credits—Material: "Starlight" Lumarith. Manufactured by Transhade Co.

1—The effect of the new plastic dim-out material is clearly demonstrated by a comparison of three views of a seashore shop. Top shows lights extinguished with the resultant impression of a shop shut down tight. 2—Here window is brightly lighted. Note glare on boardwalk. 3—Dimmed out with plastic screen. Merchandise visible, but glare is gone

1

2

PHOTOS, COURTESY FORD MOTOR CO. & TENNESSEE EASTMAN CORP

1—Quantity production of plastic tapping cups to collect liquid latex is speeded by injection molding. 2—Replacing metal cones which were being pilfered by natives for tableware, the plastic cups are stable, inert and long-wearing

Cups for crude rubber

To the Brazilian natives who dwell near the extensive crude rubber plantations of the Ford Motor Co. in the Amazon Valley, the small, conical metal cups attached to the trunks of rubber trees to catch the liquid latex were irresistably desirable objects. The shining metal cups sending off shafts of light were attractive enough intrinsically to invite attention; but when some ingenious native hit upon the expedient of flattening the bottom of the cup, thereby converting it into an efficient, functional drinking vessel, the cups disappeared at a rate of speed that far outdistanced replacements—and thereby hangs this tale.

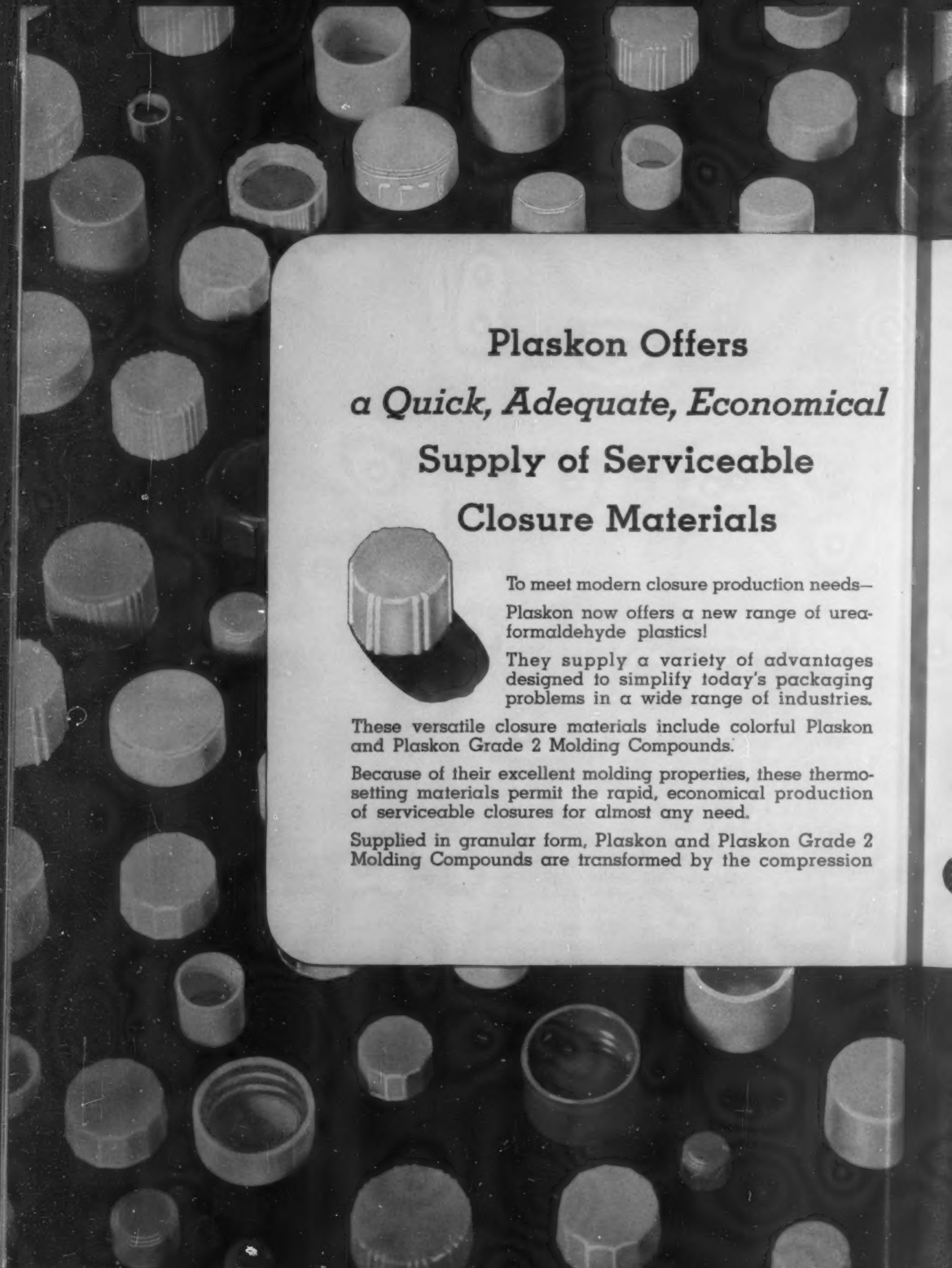
The importance of maintaining and increasing the flow of crude rubber to the United States from sources not cut off by the war cannot be exaggerated. Every pound of rubber that reaches this country today is literally worth its weight in gold; and any factor, however small, that slows up imports and thus retards production is a matter for grave consideration. The added fact that the vanishing cups were of strategic aluminum made it doubly important that they be fashioned of some substitute material less likely to be coveted.

The problem was brought back to Dearborn engineers, whose experience with plastics in automotive manufacture pointed immediately to these materials—which could not easily be reworked into drinking mugs and at the same time would release aluminum. Injection-molded cellulose acetate butyrate cups economically produced in a 40-sec. cycle were the answer. Each cup is about 5 in. in diameter, with edges flanged so that the supporting wire which is looped around the rubber tree may be secured around the cup.

The plastic cups, which weigh only 2 oz. each (a very slight variation from the aluminum units previously used) are suitable for still another reason. Young budded rubber has a tendency to coagulate in the cup immediately after it has been tapped. Each tapper therefore carries with him, as an indispensable part of his working equipment, a bottle of ammonia with a small perforation in the cork. The moment he has made his cut in the tree, and just before the latex reaches the cup, he drips a small quantity of the ammonia into the bottom of the cup to act as an anti-coagulation agent. The first few plastic cups therefore had to be tested for their resistance to ammonia, and the material proved to be stable and inert.

It may be interesting to observe that this new molding activity is carried on in the former tire plant of the company, where many of the machines for turning out tires for hundreds of thousands of cars and trucks have been stilled for lack of crude rubber. And the plastic material and equipment used formerly produced automotive parts. The use of plastic material in this application has not alone resulted in a more satisfactory end product, but has successfully taken up the slack in both materials and work hours.

Credit—Material: Tenite II



Plaskon Offers *a Quick, Adequate, Economical* Supply of Serviceable Closure Materials

To meet modern closure production needs—

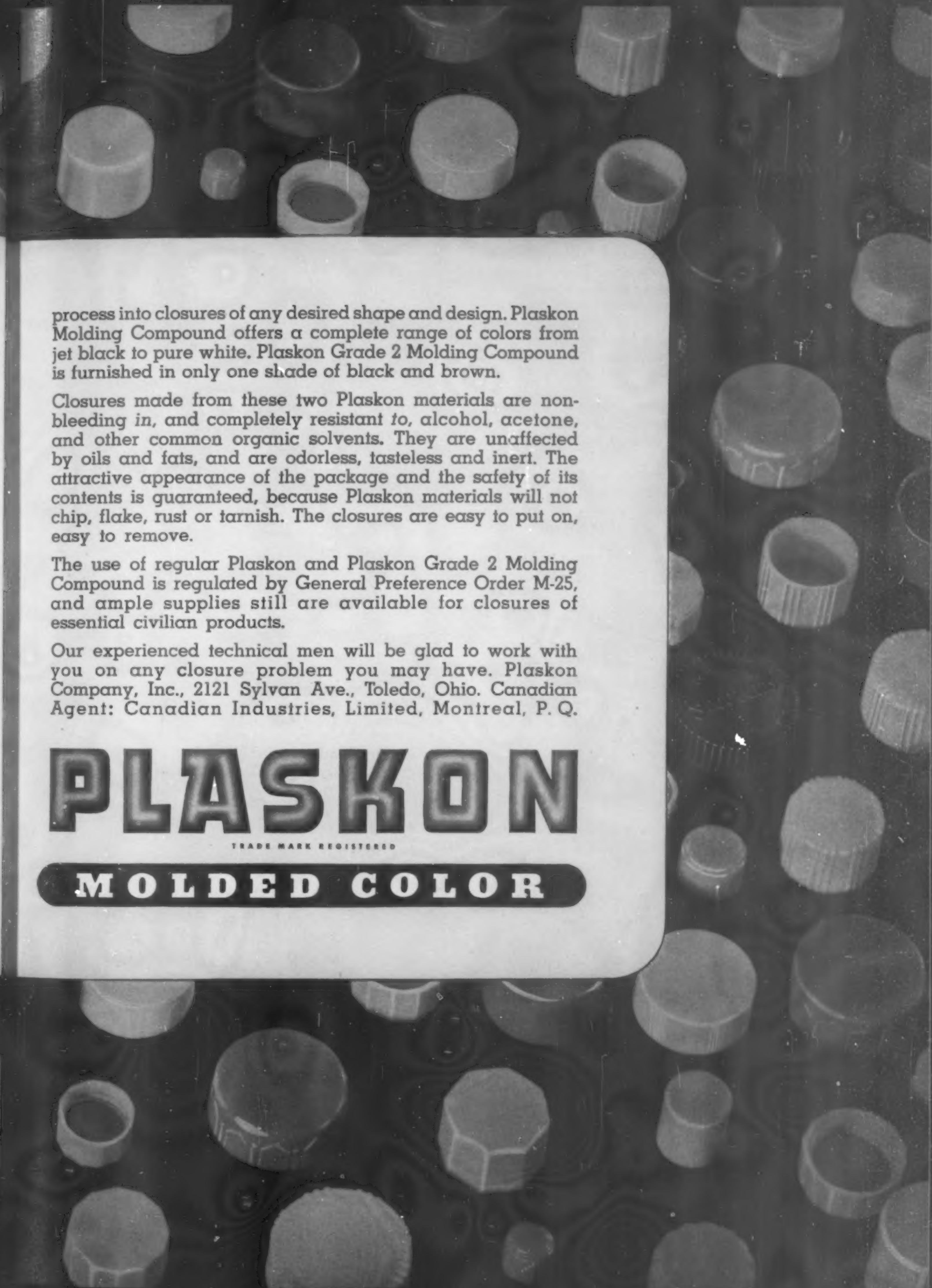
Plaskon now offers a new range of urea-formaldehyde plastics!

They supply a variety of advantages designed to simplify today's packaging problems in a wide range of industries.

These versatile closure materials include colorful Plaskon and Plaskon Grade 2 Molding Compounds.

Because of their excellent molding properties, these thermosetting materials permit the rapid, economical production of serviceable closures for almost any need.

Supplied in granular form, Plaskon and Plaskon Grade 2 Molding Compounds are transformed by the compression


process into closures of any desired shape and design. Plaskon Molding Compound offers a complete range of colors from jet black to pure white. Plaskon Grade 2 Molding Compound is furnished in only one shade of black and brown.
Closures made from these two Plaskon materials are non-bleeding *in*, and completely resistant *to*, alcohol, acetone, and other common organic solvents. They are unaffected by oils and fats, and are odorless, tasteless and inert. The attractive appearance of the package and the safety of its contents is guaranteed, because Plaskon materials will not chip, flake, rust or tarnish. The closures are easy to put on, easy to remove.
The use of regular Plaskon and Plaskon Grade 2 Molding Compound is regulated by General Preference Order M-25, and ample supplies still are available for closures of essential civilian products.
Our experienced technical men will be glad to work with you on any closure problem you may have. Plaskon Company, Inc., 2121 Sylvan Ave., Toledo, Ohio. Canadian Agent: Canadian Industries, Limited, Montreal, P. Q.
PLASKON
TRADE MARK REGISTERED
MOLDED COLOR

Lignin-enriched filler

A non-critical extender for phenolic molding compositions

by JOHN G. MEILER*

THE wide variety of molded phenolic articles that are essential to the war effort is a credit to the ingenuity both of the molding composition manufacturers and of the molders. That the variety of articles and the quantity of each will increase as war production increases is self-evident. The molding facilities available in the country can at present more than meet the need of this increasing demand, but one major bottleneck which is limiting the production of molded products is the lack of one essential group of raw materials—the phenolic resins.

The critical shortage of phenol has reduced the amount available for the manufacture of molding compositions to such an extent that the supply of the latter is insufficient to fill the demand for articles rated A-10 and higher, as well as being insufficient to keep the molding industry operating at anywhere near capacity. These two facts, (1) the insufficient amount of phenolic molding composition for war and essential civilian demands, and (2) the available press and molding capacity now idle because of lack of phenolic molding composition, have focussed the attention of the Plastics and Synthetic Rubber Section, Chemicals Branch, WPB, and that of the entire industry on extenders. The lignin-enriched filler (LEF) described in this article is one of the most promising extenders and is available immediately in quantities large enough effectively to alleviate the present shortage.

More molding composition available

Satisfactory molding compositions have been made with 20–30 percent phenolic resin and 70–80 percent of the lignin-enriched filler (see Fig. 5). The Marathon Co. can produce 20 tons of LEF per day, or 15,000,000 lb. per year. The additional amount of molding composition that can be produced with the present supply of phenol or phenolic resin depends on the composition as shown in Table I.

TABLE I.—ADDITIONAL ANNUAL PRODUCTION OF MOLDING COMPOSITION BY USE OF LEF AS EXTENDER

Resin in lignin-phenolic molding composition, percent	*Additional molding composition produced per year, pounds*
30	7,130,000
20	10,420,000

These figures are arrived at as follows: for example, 15,000,000 lb. of LEF will require 6,430,000 lb. of phenolic resin to make 21,430,000 lb. of lignin-phenolic molding composition containing 30 percent of phenolic resin. The same amount of phenolic resin, 6,430,000 lb., will make 14,300,000 lb. of a standard woodflour-filled molding composition containing the usual 45 percent of phenolic resin. Therefore, the additional production of molding composition made available by the use of LEF with the same amount of phenolic resin is 7,130,000 lb. (21,430,000 − 14,300,000 = 7,130,000 lb.). The same calculation is used in the case of the 20 percent composition, whereby 10,420,000 lb. of additional molding composition is made available. These figures are conservative, for the typical phenolic resin used with LEF has a high ratio of formaldehyde to phenol. One such type of molding composition in commercial production using 23 percent resin produced 2.5 lb. of molding compound where one was produced before from a given weight of phenol.

Production of lignin-enriched filler

The LEF is produced by cooking waste wood and waste lignin solution. The resulting product is then washed, dried,

* Research Development Department, Marathon Chemical Co.

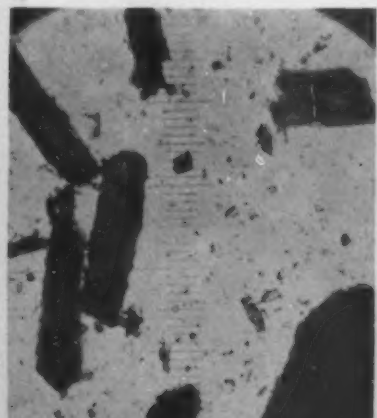
1–4—***Photomicrographs, magnified 65 times, showing number and arrangement of fiber bundles in (left to right) plastic grade woodflour, lignin-enriched filler and two other types of hydrolized wood. The lignin-enriched filler retains the fibrous character of woodflour and has the same resistance to shock***

PHOTOS REDUCED BY ONE-THIRD

1

2

3



4

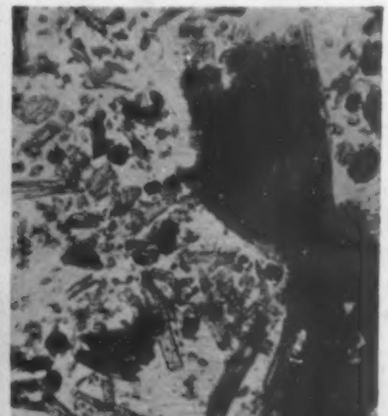


TABLE II.—PROPERTIES OF PLASTICS CONTAINING LIGNIN-ENRICHED FILLER[a]

Composition no.	Composition	% Resin	Molding conditions Temp.	Molding conditions Pressure	Water absorption, 24 hrs.	Flex. str.	Impact Izod (N) Ft.-lb. /sq. in.	Impact Izod (N) Ft.-lb. /in. (N)	Dielectric strength[b] Short time	Dielectric strength[b] Step by step	Arc res.[c]	Dielectric constant	Power factor
			°C.	p.s.i.	percent	p.s.i.			v./mil	v./mil	sec.		
RM-5815	40 parts phenolic resin per 100 LEF	28	145	2000	.17	8,520	2.61	.399	510	370	81	5.70	.060
RM-5816	30 parts phenolic resin per 100 LEF	23	145	2000	.28	10,500	2.60	.412	530	420	137	5.65	.057

NOTE:
[a] $^1/_{16}$-in. and $^1/_4$-in. samples used for electrical tests molded 5 minutes at 145 lb. steam pressure and 2000 p.s.i.
[b] Dielectric strength tests made under oil between 1-in. electrodes, voltage raised 1000 v./sec. Transformer rated at 100 kv., 25 kva., at 60 cps.
[c] Arc resistance; conducting path formed by 10 milliamp. arc during first three minutes (intermittent). Average time in seconds reported.

ground and screened. The cooking process has four distinct advantages:

1. It converts the non-plastic lignin in wood to a plastic form.
2. It precipitates the lignin from the lignin solution directly on and in the fibers, giving them an enriched lignin content.
3. It pulps the wood, which allows it to be easily reduced during grinding to individual fibers and small fiber bundles.
4. It removes the easily hydrolyzable fraction of wood, thereby increasing water resistance.

The photomicrograph (magnification sixty-five times—1 division = 24 microns) of the LEF shows that although it has a resin content of 35.6 percent lignin, it still retains the fibrous characteristics of woodflour and the same resistance to shock. Comparing the photomicrograph of plastic grade woodflour (Fig. 1) and standard LEF (Fig. 2), it is noted that both have some small fiber bundles (the larger pieces). In the woodflour the bundles are transparent, while in the LEF they are dark. Further, it will be seen that the LEF contains a greater number and considerably longer individual fibers, which increases resistance to shock. This shock-resistant property is further shown in the high impact of the lignin-phenolic molding composition—.4 ft.-lb. per in. of notch as compared to the .25 to .3 ft.-lb. for standard grades of phenolic molding compositions.

The cooking and processing of hydrolyzed wood is capable of wide variations as shown in the photomicrographs (Figs. 2, 3 and 4). It is always possible to increase the plasticity at the expense of impact, or to increase the impact at the expense of plasticity. However, recent experimental results have produced a modified LEF that has an impact strength 100 to 150 percent higher than usual without decreasing the plasticity. Research and development work directed to the improvement of specific properties, such as impact strength, is being carried forward very actively.

Photomicrographs of two hydrolyzed woods made by two other companies are shown in Figs. 3 and 4. The product in Fig. 3 retains the wood almost entirely in fiber bundles. This product coats well with resin, but the molded product lacks flexural and impact strength. The product in Fig. 4 is hydrolyzed to a fine powder which gives better flow, but again the molded product has inferior flexural and impact strength. A comparison of the three photomicrographs of hydrolyzed woods clearly shows the compromise nature of LEF (Fig. 2) which gives it the desirable properties of (a) a superior molded

5—Sample of lignin-enriched filler. 6—Closures molded from a composition containing 30 percent phenolic resin

5

6

article, and (b) sufficient flow to give an appreciable saving in phenolic resin. The test results given in Table II bear out this compromise. The LEF used is a grade that is commercially available at the present time.

The material conforms to the following specifications: Lignin content approximately 35.6 percent; moisture content 5 percent; apparent density 0.015 gr. per cc.; particle size 100 percent through 44 mesh on Taber screen.

Compounding, tests and products

The samples which yield these results (see Table II) were made in the following way: 100 parts of LEF plus 30 parts of a liquid resin, calculated on the basis of its solids, were mixed in a blade or muller type of mixer with 1 percent of calcium or zinc stearate as a lubricant. Carbon black or dyes may be added. After this premixing, the mixture is run on rolls for approximately one minute. The rolled composition is then easily ground to give a material with a bulk factor of 2.5. This composition has good flow and has a resin content of 23 percent. Similarly, a composition containing 28 percent resin is made from 40 parts of the liquid resin to 100 parts of the LEF. The flow of these compositions is illustrated in the photographs shown in Figs. 6–8. The articles in Fig. 7 are made from a composition containing 23 percent phenolic resin. The articles in Fig. 8 are made with a composition containing 28 percent phenolic resin. All of these articles were made in the same molds and under the same pressures as were used to make the same article out of standard phenolic molding composition. The cures were as fast, or from 10 to 20 percent faster. No preheat was used. The closures in Fig. 6 are made with a composition containing 30 percent phenolic. They have equal properties and were made at the same production speeds as similar closures made from the usual phenolic molding composition.

The tests shown in Table II are representative of one type of molding composition and the results have been duplicated repeatedly. The tests of flexural strength, water absorption, and impact have been made by the National Bureau of Standards[1] who have checked our results within the experimental error.

Note that the flexural and impact strengths increase as the phenolic resin content decreases. This is invariably true, as might be expected. Note also that the water absorption is only slightly affected by resin content. It was found that compositions containing only 16 percent phenolic have water absorptions in this same range. This leads to the interesting conclusion that articles which require only low flow can be made with resin contents between 10 and 15 percent, and have excellent physical properties. Another interesting fact is the increase of arc resistance with a decrease in resin content. The laminated product made from the same lignin-enriched pulp containing no phenolic resin has an arc resistance time of 183 seconds.

It is evident from the molded articles, from the acceptance by a number of large molders and suppliers, and from the above test data that a satisfactory and possibly superior molded product can be made from LEF plus a limited amount of phenolic resin. Furthermore, if the 15,000,000 lb. of available LEF were used, between 7 and 10 million lbs. per annum of additional satisfactory molding composition would be available without the use of any more phenol than is now being used. This would alleviate to a large extent the present shortage of phenolic molding composition needed to meet the vital civilian and war demands.

To illustrate, let us take any of the industries that use a large volume of phenolic molding composition and who are able to get material on an A-10 rating or better. The closure field is a good example, for here the stoppage of metal closures has created an even greater demand for plastic closures. As a closure material, the LEF has been very successful. In other words, if the available supply of LEF were used for closures, production could be maintained at present capacity, and yet only one-half of the phenolic resin previously used would be required. The same increase in production could be illustrated by articles other than closures. Furthermore, since there is only so much phenol and phenolic raw material available and it will make only so much standard phenolic molding composition, if any one type of article can be made of an extended material and thus save phenolic resin, then more phenolic molding composition will be available for the rest of the molders so that the entire industry will benefit.

7

7—Articles molded from 23 percent phenolic composition

8—An article molded of composition containing 28 percent phenolic resin at the same pressure and using the same mold as if it had been made of standard phenolic compound

8

[1] Modern Plastics 19, May 1942, page 47.

(Please turn to page 128)

Plastics ENGINEERING

F. B. STANLEY, Engineering Editor

WITH this issue we present a new feature, Plastics Engineering, under the direction of our new engineering editor, Frederick B. Stanley.

Mr. Stanley was educated at Washington and Lee University and the Massachusetts Institute of Technology, from which he was graduated with a B.S. degree in mechanical and electrical engineering administration. Originally with the research department of the Western Electric Co., he joined the staff of Mack Molding Co. in 1932.

We feel that his experience there makes him unusually well qualified to be editor of Plastics Engineering. He started as a molder's helper, worked his way up to foreman and then to sales engineer, which position he has held for the past five years. He was also assistant sales manager of the company when he resigned to join our staff.

Thus Mr. Stanley knows the problems of production and sales, and realizes that in synchronizing the two departments engineering plays an important rôle.

In Plastics Engineering we are going to present new ideas, solutions to tricky production problems as they have been worked out by various molders, and other engineering information which will add to the general knowledge of plastics men. Plastics, as an industry, has grown so rapidly that new techniques are being developed daily. We are going to analyze those techniques from a practical engineering point of view. Mr. Stanley plans to visit molding plants throughout the country and bring to these pages the results of these inspection trips.

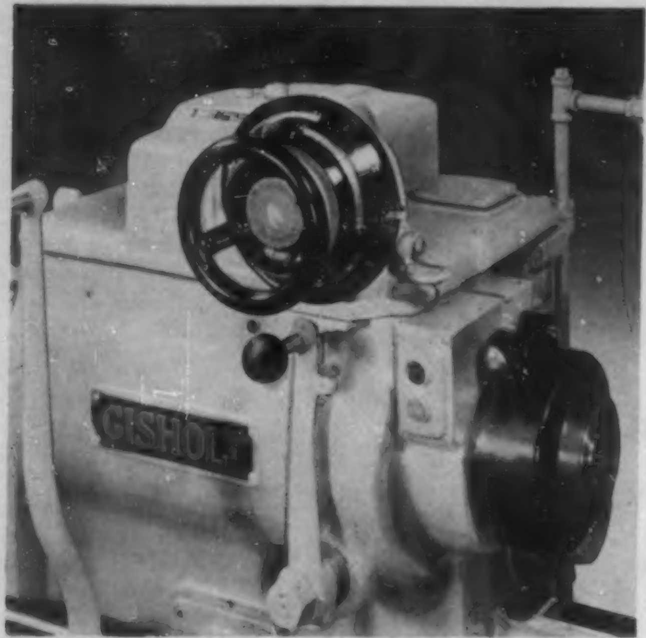
Every molder has need of this information. We are glad to bring it to the industry through Plastics Engineering, which we are proud to have edited by Mr. Stanley.

Raymond R. Dickey
Editor

Foundation of production

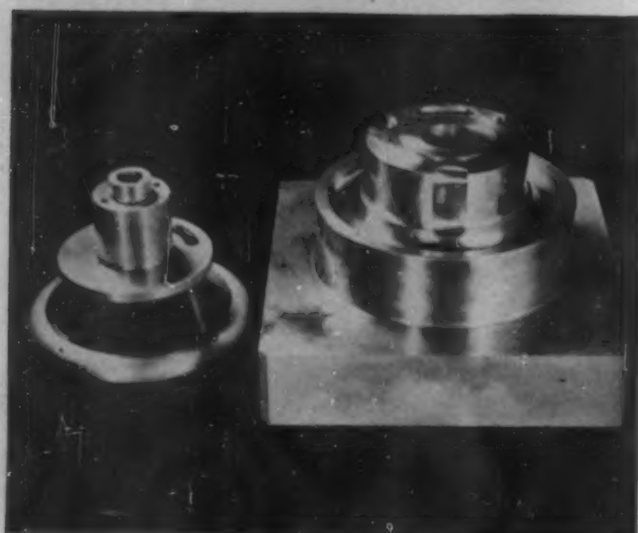
by LEE T. BORDNER*

PHOTOS, COURTESY GISHOLT MACHINE CO., BAKELITE CORP., GEO. GORTON MACHINE CO.



1

2



3

THE backbone of America's war production, machine tools are being shipped to war factories at the rate of more than 1000 per day, every day. And with these tools are built the mechanized precision weapons which have made this war so radically different and so much more devastating than the sum total of the battles fought a generation ago. In addition to filling large-scale production demands—95,000 called for originally from an industry geared to produce 25,000 annually were actually delivered within 8 months—the machine-tool builders have had to maintain extraordinarily high standards and redesign for jobs to which no peacetime counterpart offered an adequate comparison.

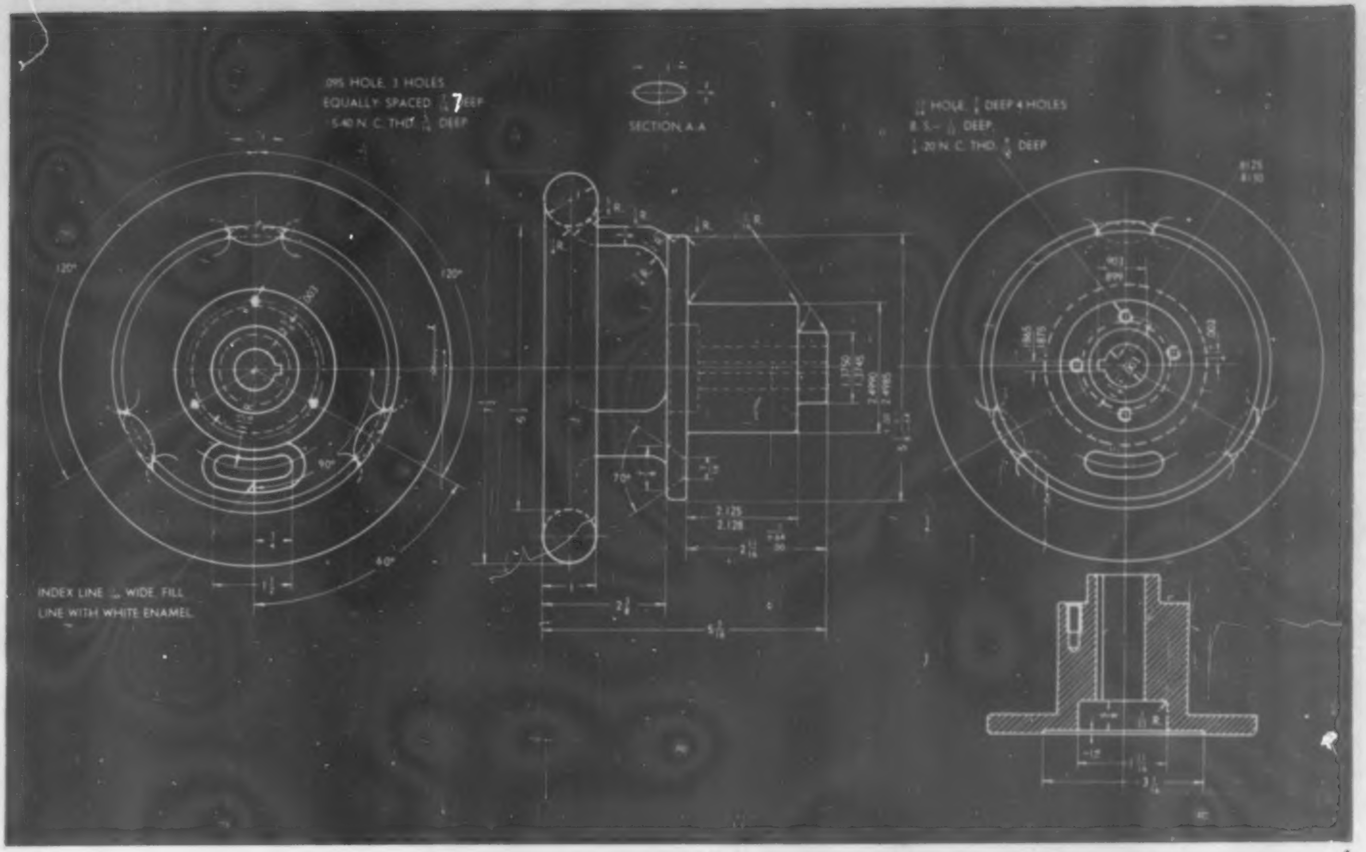
Complicated in the extreme and built to a fine degree of accuracy and rigid tolerances, machine tools have had to be produced from the best materials obtainable. But machine-tool builders, like other American manufacturers, found that the giant maw of war had swallowed a large portion of their accustomed supply. In the search for suitable replacement materials, plastics were judiciously investigated and tested. It took exhaustive research by machine-tool engineers, using all of their ingenuity and technical know-how, to apply plastics where they could be used to best advantage and, in fact, improve the functioning of these all-important machines.

Typical example of the machine-tool manufacturer who had the foresight to experiment with and adapt plastics materials was the Gisholt Machine Co. In order to determine the best materials which might be utilized in certain parts, two of the company's engineers, George Class and Larry Leifer, had checked all the parts of their machines and had carefuly charted the function, design and other engineering details covering each of these parts. After thoroughly considering these parts, certain units for turret and saddle type lathes were selected as best reproducible in plastics. A molding company's engineers were called in on this job and together they designed these parts for practical function and economical molding.

One of the first units considered as practical for plastics was the speed selector dial. This selector, which is shown to the left on the turret lathe illustrated above, is an automatic speed changing device, used to obtain quickly and easily any one of twelve available spindle speeds. After the operator has set the selector at the speed required, the machine automatically makes the shift to the correct spindle speed. The speed selector consists of three parts: a control handwheel (Fig. 4), a feet per minute dial (Fig. 6) and a speed dial (Fig. 5). These parts were formerly machined from aluminum castings.

*Sales manager, Eclipse Moulded Products Co.

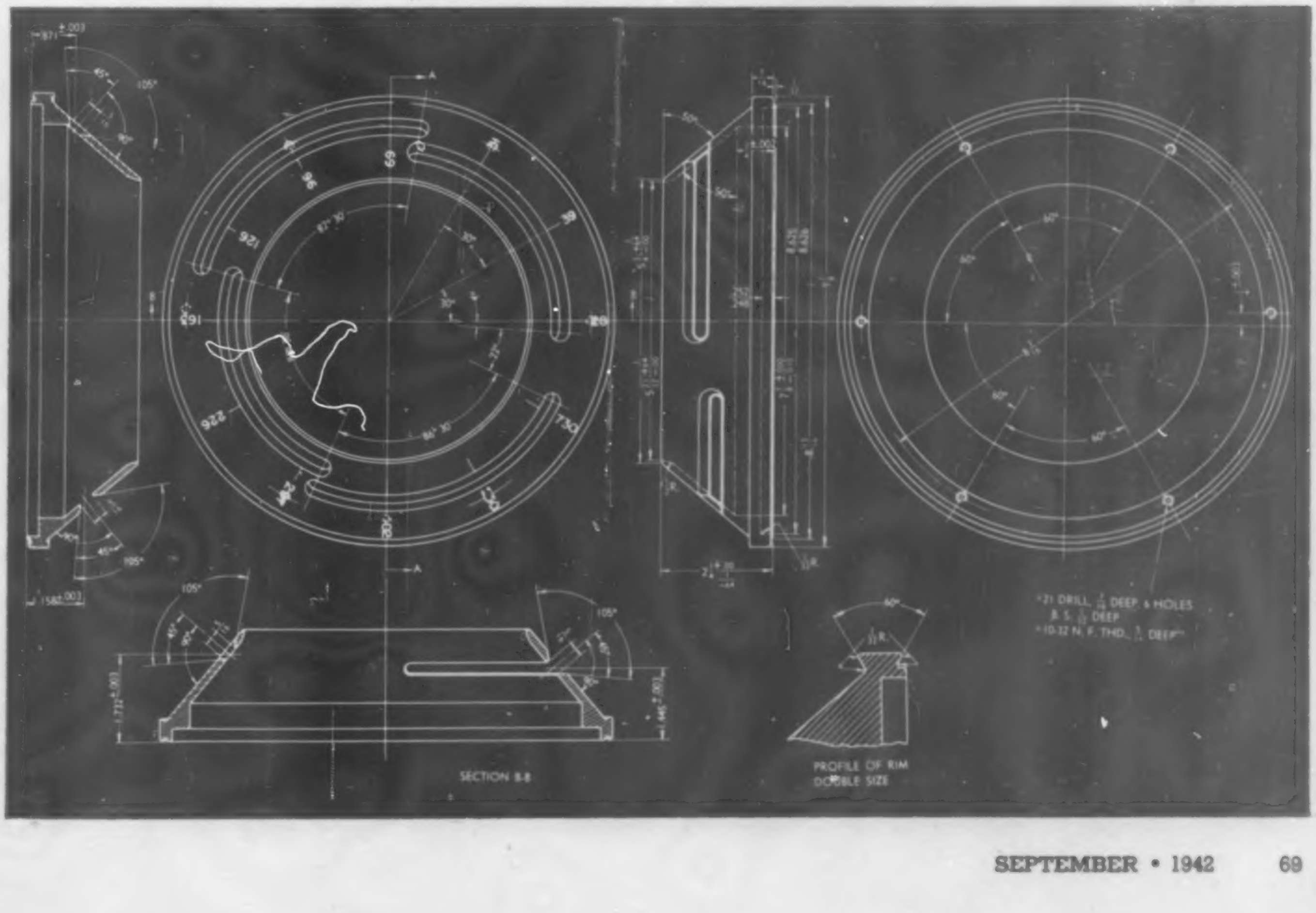
1—Molded parts not only replace strategic metal for much needed machine tools but also reduce time required to manufacture them. Outstanding examples are the speed selector unit on the front of this ram-type turret lathe and collet chuck guard (right). 2—Control handwheel (left) and speed dial are of black phenolic molded. 3—Cast aluminum handwheel (left) and mill-finished plunger mold for its plastic counterpart

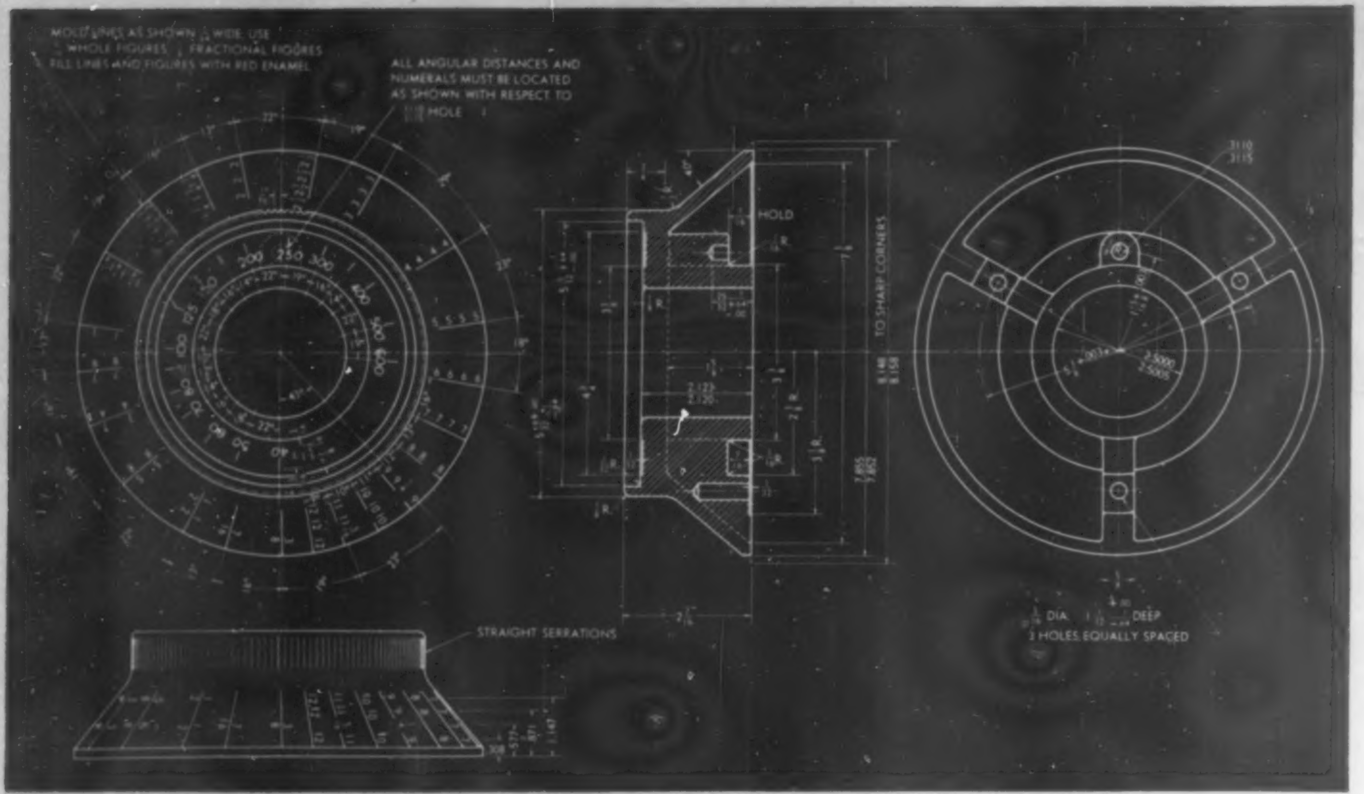


4

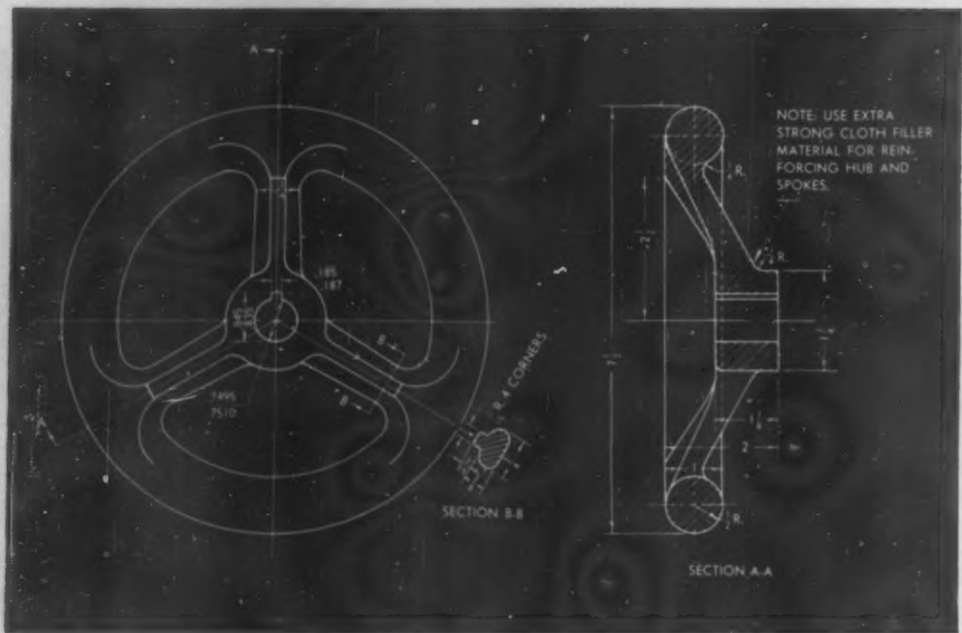
4—*Design of the speed dial handwheel pictured on the opposite page is diagramed above. Differing from its aluminum predecessor (Fig. 3, left) the plastic control handwheel was redesigned for economical molding. Spokes are placed to allow a straight draw of the force from the cavity.*
5—*Blueprint of the speed dial section shows construction required because of graduations and letters*

5





6



7

6—Feet per minute dial for the speed selector unit was redesigned with a series of vertical flutes incorporated on the gripping surface. It's made of red phenolic. 7, 8—Molded handwheels for saddle-type lathes. Diagram at left shows small cross feed wheel. Large 12-in. diameter wheel is on opposite page. Note metal ring insert in the hub

In converting these parts to plastics, only a few slight changes in design were required. A series of vertical flutes was incorporated on the gripping surface of the feet per minute dial in place of the diamond knurling previously used, thus allowing the workman to secure a more positive hold and enabling him to change required settings faster and more accurately. The spokes in the control handwheel were redesigned to allow a straight draw of the force from the cavity. This change was necessary for economical molding, as it would have required a split cavity cased with a chase if the plastics handwheel had followed the design of the metal handwheel. Particularly interesting is the method by which a former cast aluminum handwheel was produced in a substitute material. Both speed and accuracy were displayed in the shaping of the spokes in the handwheel plunger mold which was held within limits of .002 inch. Three evenly spaced spokes and insert slot were machined in the mold to match perfectly with the companion molds.

The dies for the control handwheel were constructed with large powder wells and were channeled to decrease the curing cycle. Large ejector pins were provided for in the cavity, as close limits were specified on the hub of wheel relative to draft allowances. Close tolerances were also required in the shaft hole and keyway which are molded in the hub, so careful consideration was given to material shrinkage. In order to ensure adherence to these tolerances, hardened and ground shrink plugs were used in the molded part while it was cooling. After the unit had cooled, its dimensional stability

was permanent. The mold which produced the handwheel is so constructed that the wheels can be produced either with or without a steel bushing. Such dual use of molds is not uncommon but should be provided for at the time the mold is constructed, as it is not always practical or possible to convert a die after it has been completed.

The cavities were milled at a speed of 2200 r.p.m., with cutters hand fed. Actual cutting time was 10 hr. for this part of the job, although $18^1/_2$ hr. were needed to complete the 115-lb. mold. The mold is simply mounted on a 15-in. circular table, accurate within .0005 in. and indexing to 5 min. or less. The specially ground end mills and ball nose cutters were ground on a grinder especially designed for this type of work.

The cavities for the speed dial and feet per minute dial were constructed by the hobbing process, a method selected because dials required graduations and letters on 30 deg. faces. Hobbing these cavities proved to be the most practical and economical process for producing them. A slight taper in the numbers was allowed in order to eliminate the possibility of these dials sticking in the cavity. Because of the size of these units, only single-cavity molds were made. All of the molds were of conventional semi-positive design, with land surfaces set into the block.

All mounting holes are molded in the dials and handwheel, and required threads are either molded or subsequently tapped in the parts. A white enamel is wiped in the graduations and numbers, producing bold, clear lines and numbers on the faces of the dials. Readability of the plastic speed selector is further enhanced by molding the feet per minute dial of red phenolic material and the handwheel and speed dial from a black phenolic. Not only does the combination of colors improve legibility but it saves operating time on the machine, as the machinist can check his cut from his usual working position without having to move over to the selector.

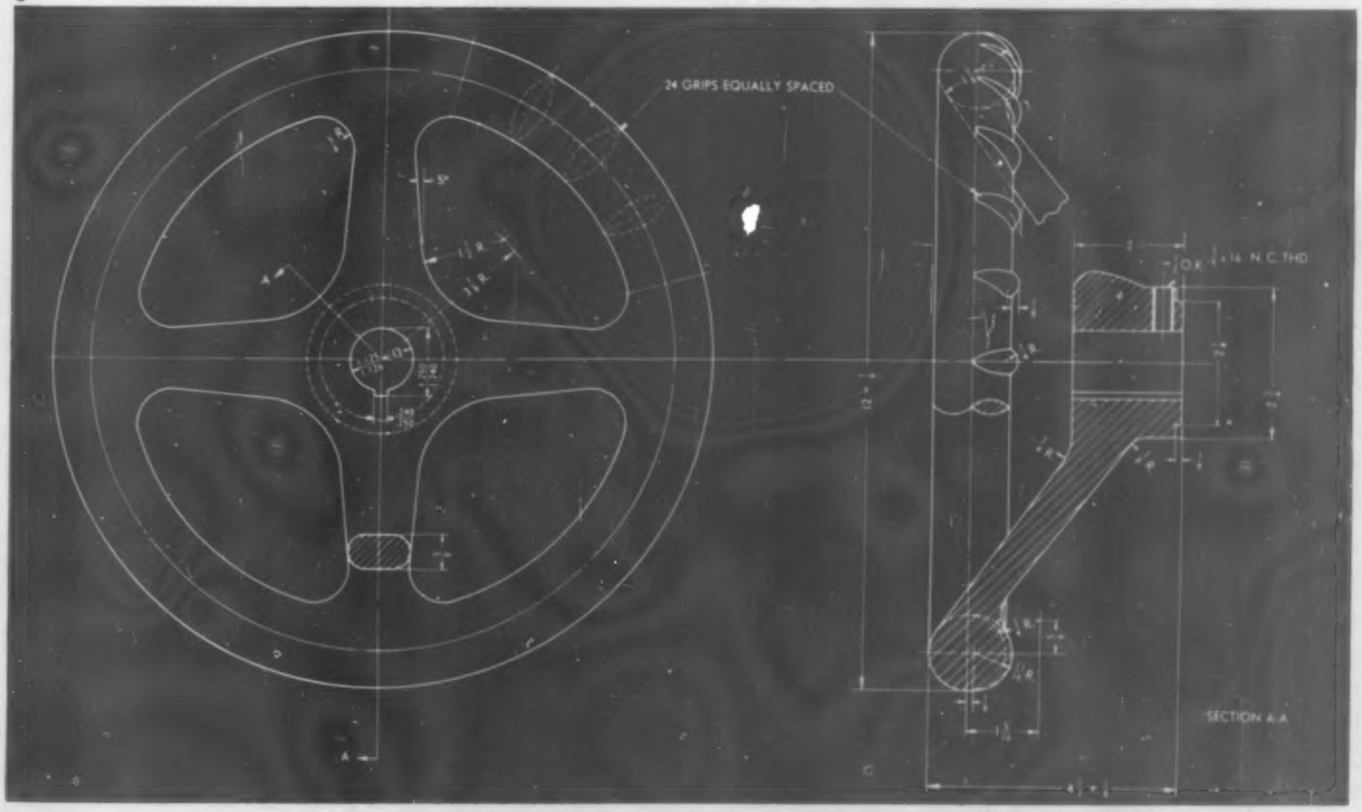
Light weight was a major consideration in converting the

PHOTO, COURTESY DUREZ PLASTICS & CHEMICALS, INC.

9—Lightweight, molded handwheels and lever knobs on this lathe are resistant to grease, oil and cutting compounds

second unit to plastics. This was a 12-in. handwheel which is used on saddle type lathes. Magnesium or aluminum had previously been specified for this unit, as weight was of prime importance in order to ensure proper operation of the machine. It was not practical to use a heavier or denser material because the momentum of a heavy wheel would allow it to turn beyond its required position. At the time this mold was constructed it was requested that it be built in such a manner that the size of the hub could be altered, if necessary, without converting the entire mold. This provision was made and fortunately so, because it was found a short time after the completion of the mold that the machine would require

8



another 12-in. handwheel which would have to have a steel stud molded into the hub of the wheel. A slight change in the cavity and force resulted in the utilization of this mold to produce handwheels with or without inserts. A side pin in the die provides a threaded set screw hole which is molded in the hub of this wheel. All other mounting holes are also molded in the wheel. As the mounting shaft hole and keyway are finish-machined in the mold, no additional machining operations such as tapping, drilling, reaming or broaching are required. These operations are all eliminated, as the piece comes from the mold machined for immediate installation.

Another unit on the turret lathes which was considered practical for plastics was the collet chuck guard (Fig. 10) These guards, formerly produced from cast iron, were clumsy and heavy to handle and required several machining and finishing operations, such as filing, reaming, drilling and tapping before installation. Painting or enameling these guards was another operation required. Because of the guard's simple design, which lent itself to practical molding, a single-cavity flash type mold was designed and constructed, which eliminated various finishing operations by molding-in threaded set screw and mounting holes. As the specific gravity of the plastic material is 1.36, as against 7.22 for iron, even though it was necessary to increase the wall section of the guard the weight was reduced. The plastic guard weighs only 2 lb. against 8 lb. for the cast iron guard. Because plastics are inert to cutting oils, greases, acids and alkalies, there are no detrimental results when these guards are exposed to such compounds. Color is an integral part of plastic parts, so the painting operation was also eliminated.

A minimum impact material was found suitable for this unit. In use it was revealed that additional strength was required at the nose of the piece, and after subsequent experiment it was produced with an increased thickness in the nose. This resulted in a unit which was eminently practical.

Before proceeding with the production of these parts, careful consideration was given to various materials and exhaustive tests were made on them. The results of these tests and experiments disclosed that a medium impact thermosetting phenolic material possessed the physical and mechanical properties required. Molded parts of this material had an impact strength of 10,000 lb. per sq. in. and a tensile strength of approximately 8000 lb. per sq. in. They successfully withstood heat tests up to 400° F. and their moisture absorption was less than 1 percent gain after 48 hrs.' immersion. The material has good flexural strength, adequate dimensional stability and compares favorably with the metal it replaces. Permanent hardness and density ensure resistance to shock, impact and abrasion. Parts have high dielectric properties, are unaffected by heat up to 400° F.

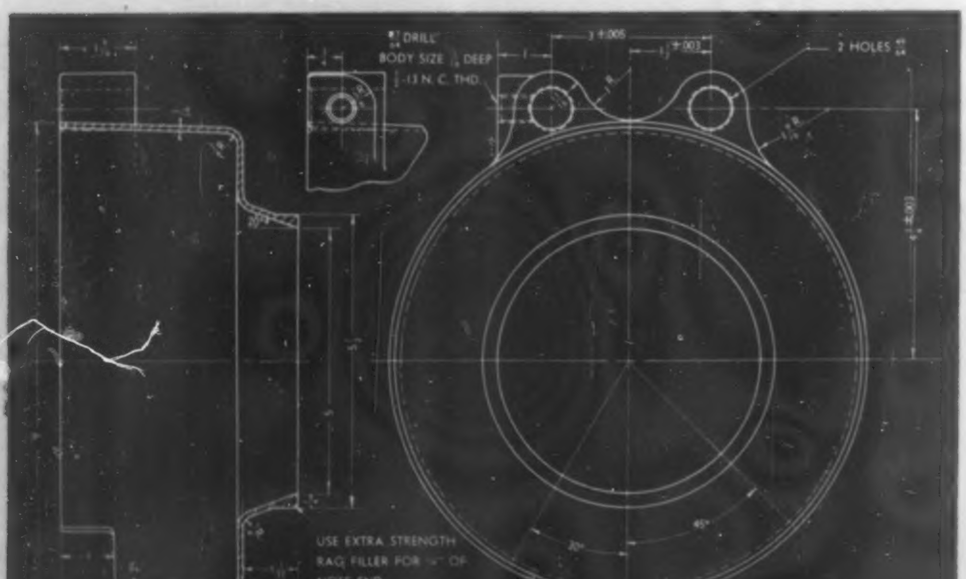
The castings described above are molded by the compression molding process, using 500-ton self-contained semiautomatic hydraulic presses. Identical processes are used to produce these parts in most respects, varying only in required temperatures, pressures and time cycles, according to the size and design of the part. Materials are preheated to 150°–180° F. and are molded at temperatures ranging from 300° to 340° F. Thickness of sections, use of inserts and side pins determine the time cycle required to produce these parts. Time cycles ranged from 6 to 18 minutes. The molds were made from 5 percent nickel steel, carburized and hardened to 50°–60° Rockwell.

It is not our intention to convey the idea that plastics can replace steel, bronze and other metals and materials in all machine tool parts. There are, however, several parts on almost every machine tool, such as switch-plates, lever knobs, nameplates and pre-selector drums, where they can be practically and economically utilized. The phenolic material used in these applications can be threaded, drilled or tapped, when necessary, as readily as metals. Numbers, letters, bushings and inserts can be molded into the part.

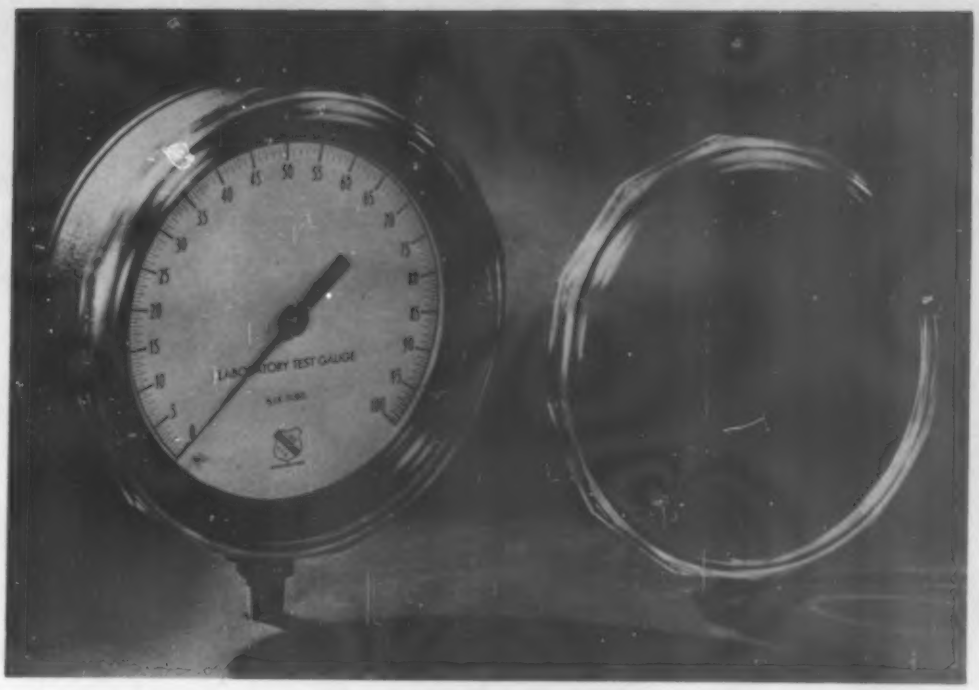
In the parts described, molded plastics proved lighter in weight, thus minimizing overtravel of dials and handwheels; reduced many extra machining operations and consequently the number of man-hours required to make the machines; provided parts of consistent accuracy and satisfactory impact strength; improved operating efficiency and legibility of dials; and provided units which were resistant to water, oils and coolants.

While the urgency of war industry demands stimulated the application of plastics by zealous engineers working against time, the fact that plastics are standing up through a most vigorous workout seems to indicate that a real contribution has been made to the machine-tool field.

Credits—Materials: Bakelite, Durez. Molded by Eclipse Moulded Products Co. Small cross feed wheel by Barber Coleman Co.



10—*Simple in design, the molded plastic collet chuck guard weighs only 2 lbs. in comparison to the 8 lb. cast iron guard it replaces. Molded- in mounting holes and screw eliminate drilling and finishing. It is shown in position in Fig. 1*



Wearing its new face of clear acrylic, this laboratory test gage, like others molded by the same company, is easy to see through, hard to break. The face is molded in one piece to include the bezel and the retaining ring

PHOTO, COURTESY MANNING, MAXWELL & MOORE

Molding a one-piece gage face

WITH the advent of acrylic molding compounds in 1937, J. V. Tracy, manager of Ashcroft Gauge Div. of Manning, Maxwell & Moore, realized his ambition to equip the company's gages with a one-piece face. When Mr. Tracy originally conceived the idea of this unit, which was to include the bezel, retaining ring and protecting front, no proper material was available so he merely sketched up the idea and filed it for future reference. But perfection in acrylics led him to resurrect his sketch and call on a plastics molder to collaborate in the design. It was found that the quantities used made it feasible, economically, to tool up for four standard sizes of $3^1/_2$ in., $4^1/_2$ in., 5 in. and 6 in. diameters. However, only one mold was built at first so that any errors in design could be corrected before completing the other three sizes.

A two-cavity injection mold was constructed with the molded piece gated at the side as shown in the drawing of the part just as it comes from the mold. Also note in this drawing that the original section A-A was .250 in. and original section B-B was $^3/_{32}$ inch. This fact was the cause of the greatest difficulty encountered in the entire job.

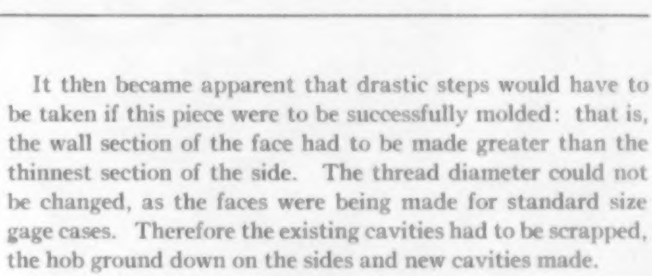
When the material was injected, it followed the path of least resistance around the thick wall section on the side of the piece, then closed in on the top of the face and welded at point (1). This, of course, trapped air at this point and left a small hole and black appearance which most molders call a burned spot. In attempting to eliminate this difficulty, the gate was made about $^1/_2$ in. thick and radiused upward as shown by dotted line (x . . . . x). Thus the material was given a freer flow toward the top of the piece. In addition, a large air vent was ground at a point opposite the gate. The only result of these two changes was to move the weld point a short distance farther away from the gate to point (2).

It then became apparent that drastic steps would have to be taken if this piece were to be successfully molded: that is, the wall section of the face had to be made greater than the thinnest section of the side. The thread diameter could not be changed, as the faces were being made for standard size gage cases. Therefore the existing cavities had to be scrapped, the hob ground down on the sides and new cavities made.

The top section was then made about .010 in. thicker than the thinnest side section, as shown by the revised dimension A-A, .095 in., and revised B-B, .105 in.; and with a normal gate and vent, the piece welded at the vent. Thus there was no mar on the face and the gage could be seen properly.

Samples were run from acetate, polystyrene and acrylic molding powder. The acrylic was chosen from these three because it had better clarity than acetate or polystyrene and was not so brittle as polystyrene.

The strength test, while unique, was severe. The samples were thrown on the floor several times for shock and then C. H. Sugden, chief engineer of the Gauge Division (who weighs over 200 lb.), placed his heel in the center of the face and bounced up and down. As the (*Please turn to page 120*)



Scarfed joints in plywood

by THOMAS D. PERRY*

WEATHERPROOF and waterproof plywood, hot press bonded with synthetic phenol resin adhesives, is finding a multitude of new applications in the war industries, particularly for many types of aircraft and small boats. Plywood has suddenly become a product of outstanding importance, since the intelligent use of such plywood will release equivalent amounts of essential and scarce sheet metals.

Normal plywood ordinarily comes in standard sheets, 4 by 8 ft., or smaller. This standard size has been established by general usage, based on the fact that most hot press sizes are in that range, and rotary veneer is seldom more than 100 inches. A very few hot presses are larger, and sliced veneer is sometimes made up to 16 ft., but this larger plywood commands a substantial premium and at that is limited to 16 feet.

Designers in the war industries became keenly aware of this size limitation and began to demand plywood 16 and 24 ft. long, and even larger. In one case a New Orleans boatyard required panels 7 ft. wide by 84 ft. long.

This demand awakened a new interest in scarf jointing, which had been used in truck bodies around the 1920's, when waterproof plywood was first made with hot pressed blood albumin glue. Scarf jointing as a principle is old, but it has never been extensively practiced in the plywood industry. Hence its revival calls for a review of its essential features.

Fundamentals of scarf jointing

The purpose of scarf jointing is to enlarge the size of the plywood sheet and to maintain, as far as possible, its normal strength without increasing the thickness at the joint. A well-made scarf joint, with a predominance of side wood, will preserve from 80 to 90 percent of the normal strength of plywood. Scarf joints in end wood alone frequently are lower in strength, but can be improved by proper technique.

Major factors to be considered in making a good scarf joint:

1. Standard scarf designs.
2. Cutting the bevels.
3. Bonding the lapped ends.
4. Arrangement of multiple sheets.

* Development engineer, Resinous Products & Chemical Co., Inc.

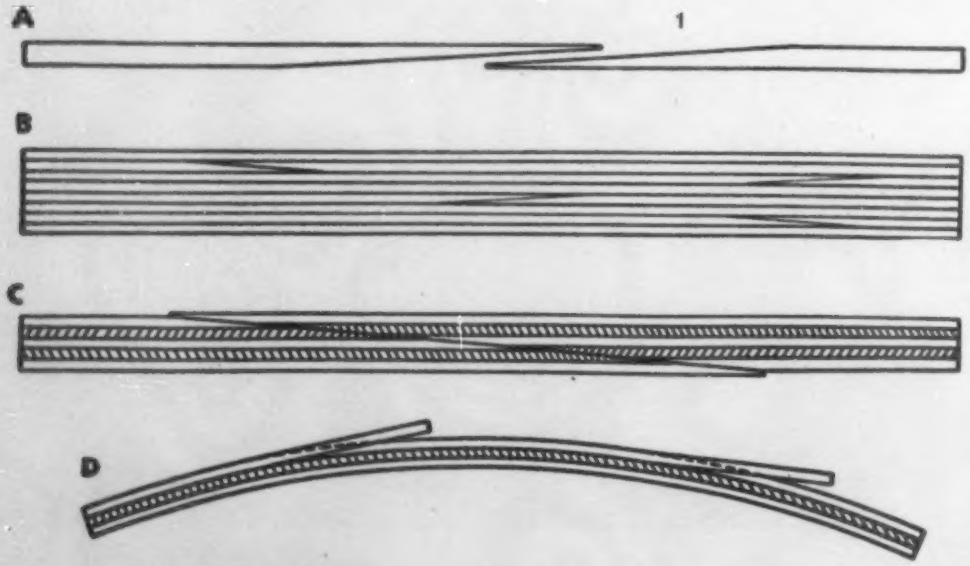
Standard scarf designs

In either plywood or laminated constructions, the individual layers of veneer may be scarfed separately, under suitable conditions. However, proper staggering of the resulting joints is essential to develop approximately the full normal strength. In other instances it may be preferable to scarf joint the completed plywood. In this case, it is absolutely essential to maintain both uniform ply thicknesses and uniform panel thicknesses. A difference of as little as $^1/_{64}$ in. may affect seriously the ultimate strength.

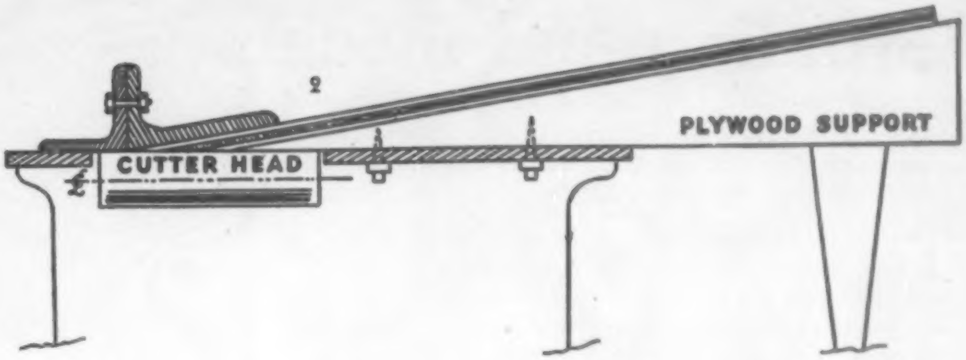
Careful testing has developed the fact that the length of the tapering scarf must be from 10 to 15 times the thickness of the members to be joined. The recent Army-Navy Aeronautical Aircraft Specification AN-NN-P511a (April 1942) requires that "the slope shall not be steeper than one in twelve." The beveled surfaces for splicing must be cut true and accurately fitted, so that there will be close surface contact over the whole area of the joint. The "toe" or tip of the scarf should be slightly blunt, and not feathered down to a ragged edge.

Single ply scarfs

A scarf in the individual veneer layers is shown in Fig. 1, which represents a laminated spruce spar for aircraft, and a variant in plywood construction. Here the ends of the single layers are tapered or beveled on a 15:1 ratio (A), leaving a slightly blunt end, since tapering to the vanishing point would be difficult to manipulate and would result in a bond of uncertain strength. After the individual scarfed joint has been completed, the separate layers should be planed or surfaced to an even thickness. They are then assembled into the laminated product, with due regard to the location of the joints, as shown in Fig. 1 (B). The Army-Navy Specifications above referred to stipulate that such joints "shall be staggered a minimum of 6 inches between the centers of the scarfs." With such staggering, the total strength of the ultimate assembly is usually equal to, or greater than, that of a similar piece of solid lumber of the same aggregate dimensions.



1—The development of excellent synthetic resin bonding agents has increased the use of plywood in war industries, and in the wake of increased use came greater interest in scarf joints. Here are four types of standard scarfed joints. A—Shows the shape of the scarf. B—Laminated spar construction, with scarfs. C—Scarf joint in flat plywood. D—Scarf joint in molded or curved plywood



2—Producing the proper scarf taper on large sheets of plywood requires skill and precision. Shown here are attachments for a 12-in. jointer, which not only holds the scarfed edge against the revolving knife, but supports the rest of the plywood sheet in a flat position

This is due to the fact that the grain of the individual adjacent layers is never exactly parallel, and these diverse grain directions provide a bracing effect which usually imparts enough additional strength to offset any weakness in the individual scarf joints.

The problem of scarfing large sheets of veneer before assembling them into plywood presents some rather serious difficulties, although theoretically it is the better way to make strong scarfed joints. Its practicability depends on many factors, such as the thickness and flatness of the veneer, its area and the availability of proper equipment to cut an accurate bevel. Except in such cases as the laminated spar described above, it is seldom done, but its advantages are obvious.

Scarfing plywood

A scarf joint in plywood is shown in Fig. 1 (C). The same fundamentals are to be observed as in the single veneer scarf previously described. It should be noted that the same blunt toe is required, but this thin toe should "ride" slightly above the "heel," or thick section of the scarf ($^1/_{64}$ in. to $^1/_{100}$ in. on $^1/_4$-in. plywood). This is important to ensure adequate pressure and close contact over the whole beveled surface, since wood compresses slightly under combined heat and pressure, and an initially flush surface inevitably becomes a depressed area. This "ride" will also compensate for the slight thickness variations that often occur in hot resin-bonded plywood. If the toe is slightly higher than the surrounding plywood after the scarf bond is completed, it may be removed by subsequent sanding. Soft-textured woods require more surplus thickness than hard, dense species.

It is also important that both sheets to be scarf jointed together be of the same moisture content. When a scarf joint is bonded with heat, there is inevitable compression, but this compression is distinctly greater as the moisture content is increased. Hence, divergent moisture content will result in uneven compression, and often reduce the pressure on the scarfed area below the safe point for a strong bond.

In molded plywood, made by the flexible bag process, scarf joints may be made in the single veneer sheets before assembly, much as previously outlined for spar constructions. Another simple and convenient procedure is shown in Fig. 1 (D), where the inner end or edge is scarfed, and the outer is left square. This avoids open joints in the outer layer, and reduces the labor of accurate fitting. The projecting veneer ends can be sanded off after the adhesive has set.

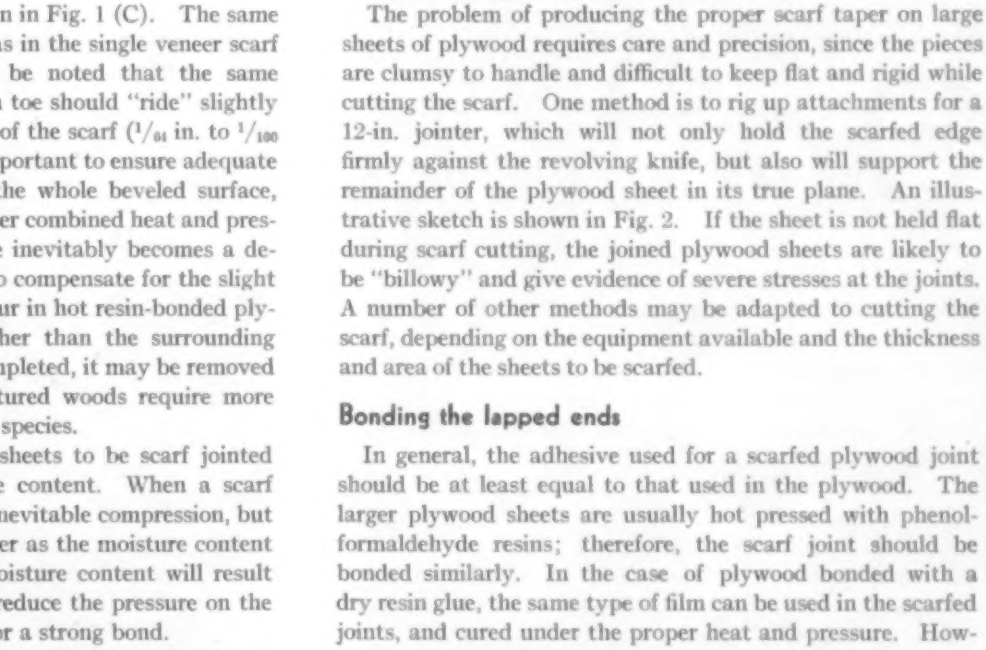
Cutting the bevels

The bevel cut for the scarf must be true and in a uniform plane, so that the fitting together will bring the cut surfaces into close contact. The toe, or thin edge, should be slightly blunt and not ragged. Either a flat sawn scarf or one made with a revolving cutter head is preferable to one made on a band saw, which may be wavy or uneven. A scarf bevel should not be sanded, as this is likely to result in a slightly convex surface with rounded edges.

The problem of producing the proper scarf taper on large sheets of plywood requires care and precision, since the pieces are clumsy to handle and difficult to keep flat and rigid while cutting the scarf. One method is to rig up attachments for a 12-in. jointer, which will not only hold the scarfed edge firmly against the revolving knife, but also will support the remainder of the plywood sheet in its true plane. An illustrative sketch is shown in Fig. 2. If the sheet is not held flat during scarf cutting, the joined plywood sheets are likely to be "billowy" and give evidence of severe stresses at the joints. A number of other methods may be adapted to cutting the scarf, depending on the equipment available and the thickness and area of the sheets to be scarfed.

Bonding the lapped ends

In general, the adhesive used for a scarfed plywood joint should be at least equal to that used in the plywood. The larger plywood sheets are usually hot pressed with phenol-formaldehyde resins; therefore, the scarf joint should be bonded similarly. In the case of plywood bonded with a dry resin glue, the same type of film can be used in the scarfed joints, and cured under the proper heat and pressure. However, it is advisable to use two sheets of film between such porous surfaces as the angling (*Please turn to page 116*)



3—Sketch of a typical press for curing the resin-treated scarf joints, showing cross-section of clamps and hot plates. A—Tables to support plywood sheets. B—Clamps to hold plywood in alignment. C—Hot plates to apply bonding pressure. D—Aluminum cauls to avoid edge depressions

Grinding and machining cast resins

by CARL E. HOLMES*

THE adaptability of plastics to the war effort is becoming more apparent day by day as restrictions on the use of brass, aluminum and steel are steadily increasing. The cast-resin group is fast becoming one of the top ranking favorites, due to its excellent qualities for machining and fabricating. The ease with which close tolerances are maintained in screw machines, as well as in other machine tools used in the metal-working industry, makes cast resins extremely valuable to the defense program.

Cast rods in practically any desired size may be purchased centerless ground to within .001-in. tolerance, thereby being ideally applicable to numerous jobs where thin disks or washers are desired. These are produced by using the regular cutting-off methods in screw machines and lathes, or by the use of thin abrasive cutting-off wheels. Various shaped rods and tubes are also obtainable, such as hexagons, octagons, squares, rectangles and triangles. In fact, practically any specified shape may be made up for individual applications, then machined to special requirements. Machining operations, such as turning, milling, drilling, tapping and threading, are performed by the use of the regular machine shop equipment with a slight variation in the tool set-up.

Screw machines and lathe operations

Round centerless ground rods are easily adaptable to the standard collets in screw machines; and by the use of special collets other shapes such as hexagons, octagons, squares, rectangles, etc., may successfully be machined on a fast production basis. High speeds and slow feeds are especially recommended.

The turret stations may be utilized just as when brass or steel parts are produced, namely: a stock stop in the first station of the turret, a center or starting drill in the second station and special drills, reamers, counterbores, taps or dies in the remaining stations. Specially shaped form tools may be used in the tool posts on the cross slide, but flat form tools are preferred instead of the standard circular tools due to the fact that a 15° clearance and a flat or negative rake are desired. The tool should be set at approximately 2° above the center of the turned piece. Careful honing of the cutting tool to a very smooth and sharp edge greatly increases the efficiency of the tool.

High-speed steel tools are generally used; but for a long production run the carbide-tipped variety has proved extremely satisfactory, because thousands of exactly duplicated pieces may be run without the necessity of regrinding, and the time for set-up can be eliminated. The spindle speeds range from 450 to 6000 r.p.m., depending upon the diameter being turned, but this speed may be easily ascertained by using 600 ft. per min. as the standard for turning cast resins. The long ribbon shavings and dust produced by these turning and drilling operations may be very efficiently removed from the machine by the installation of a blower system. This saves valuable time in sorting and cleaning the finished parts, which are ready (in most cases) for the tumbling barrels if the removal of tool marks is essential.

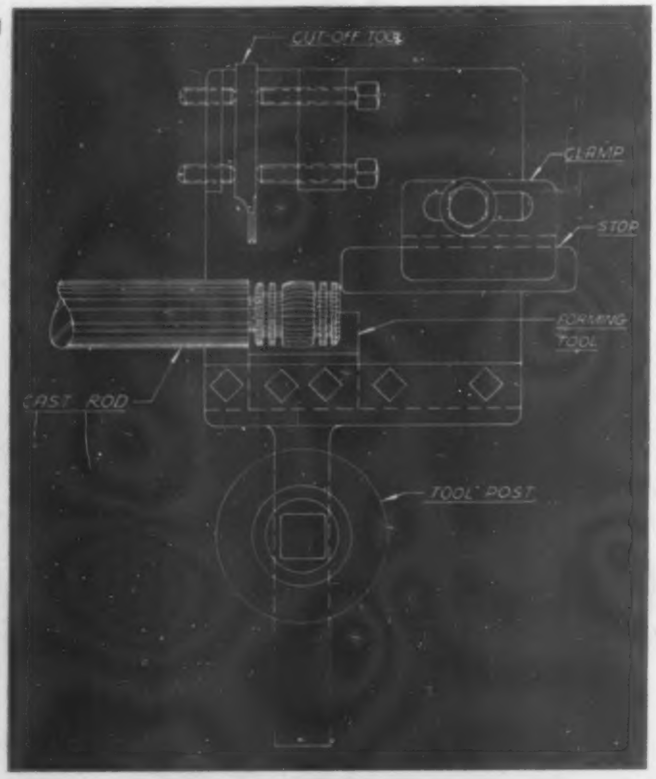
Various sizes of lathes regularly used in machine shops may serve for the turning and shaping of cast resins by the use of tools held in the tool post, or by using a rest for regular wood turning or forming tools. Many varied and intricate shapes may be produced by this method but naturally it is not recommended for high production runs. However, by the installation of a specially built tool holder in the tool post, as illustrated in Fig. 1, any conventional lathe may be turned into a very efficient production machine.

Drilling

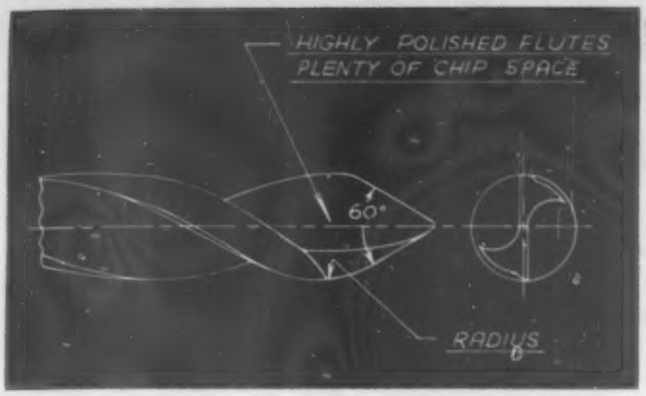
Satisfactory results may be obtained in drilling holes up to $^3/_{16}$-in. diameter by using the regular standard high-speed steel drills, such as are employed in the drilling of steel, with a slightly negative rake ground on the cutting lip. It is advisable to back out the drill often to avoid burning, as very high speeds are advocated. Speeds ranging from 2800 to 12,000 r.p.m. are used for small holes, or 100 to 300 ft. per min., but when the material has high abrasive qualities the speed may be reduced to approximately 75 ft. per minute. A thin jet of compressed air directed as near the hole as possible and directly on the drill helps to keep it cool.

Specially designed drills for plastics are available and should always be used in drilling holes larger than $^3/_{16}$ in. diameter. These drills have highly polished flutes, maximum chip clearance, slow helix for through holes, fast helix for blind holes with a 55° point ground for thin sections and a 90° point for thick sections. Figure 2 illustrates the method of grinding drills for plastics that includes a slight radius at the end of the lip which helps to maintain the hole size. However, due to the abrasive action of some materials, drills sometimes cut as much as .003 in. undersize, necessitating frequent inspection.

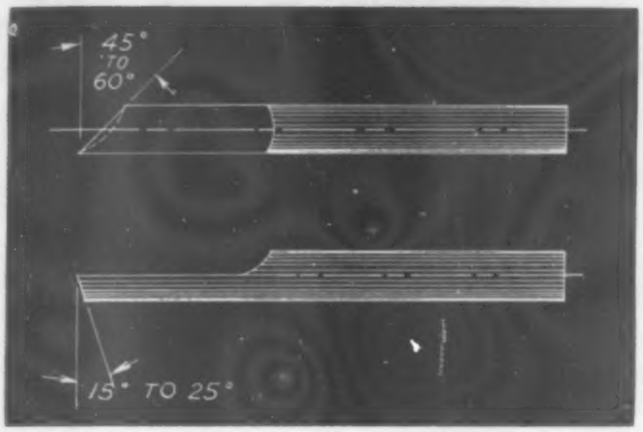
1



* Chief engineer, Engineering Specialties Corp.



2



3

Multiple spindle drill presses are often used where several holes are specified in a part. This greatly accelerates production but in cases where these machines are not available, drill jigs may be used to insure correct location of holes. When drilling holes, while parts are being turned or formed in screw machines or lathes, a single lip drill or a regular boring tool may be used to good advantage, but it is advisable to grind the tool as illustrated in Fig. 3.

Threading and tapping

Regular standard taps may be used for tapping of cast resins but the ground high-speed steel taps have proved more satisfactory. Chrome-plated taps with highly polished flutes are recommended for long production runs. Very little rake and plenty of clearance are desired as some of the highly abrasive materials occasionally cause the taps to cut very close to size, and binding is often experienced when backing out. This condition will be improved if clearance is ground on the sides of the threads. Three flutes instead of four give better results and longer life.

A speed range of 40 ft. per min. has been recommended for .236-in. taps and 54 ft. per min. for .0590-in. taps. Water has proved more efficient than oil or kerosene but dry tapping is even better for the least wear. Due to the abrasive action of some cast resins the taps are inclined to cut very close to size and as wear is experienced the holes will become undersize. Therefore, close inspection is advised where tolerances are low. Most fabricators of plastics prefer to use taps that are oversize to the high limit, thereby greatly decreasing the possibility of rejected parts due to undersize threads.

External threads may be produced by the use of self-opening dies with high-speed steel chasers that extend out in front, having less chamfer than the standard chasers. Plenty of clearance is essential and dies should be kept sharp at all times. Thread cutting in lathes is accomplished in exactly the same manner as in brass or steel, although cuts of over .007 in. should not be used due to the danger of chipping or cracking the thin sections.

Thread milling machines are excellent for milling medium or large diameter threads, as the hobs or cutters used in these machines are very accurately ground to size and to the number of threads per inch. The hobs are made for the desired length of the threads and are usually made of high-speed steel to stand up under the high speeds desired in production. By the use of cams installed in the machines one complete revolution of the piece is all that is required to produce a smooth milled thread that can be held to very close tolerances.

Thread grinders are sometimes used to grind threads in plastics. At this time, however, most owners of thread grinding equipment are swamped with orders for thread gages urgently needed to check production parts for the war effort. In fact, many producers find it impossible to keep up with the demands made upon them for these ground parts.

Reaming and milling

Although it is sometimes necessary, reaming plastics is not recommended. It is best accomplished by the use of expansion reamers with self-centering floating holders. A speed of not over 50 to 100 r.p.m. is used with a very fast feed. Close inspection is necessary on all reaming operations due to the abrasives in the materials rapidly dulling the sharp cutting edges of the reamer, causing a binding and squeaking condition that is likely to cause breakage as well as producing undersize holes. It is often advisable to drill the hole to within .001 in. in size and burnish it to the required size by the use of a very highly polished hardened rod pushed through the hole.

Milling operations may be accomplished by the use of any standard milling machines using standard cutters. However, the carbide-tipped variety is especially recommended for long production runs due to the increased speed available and valuable time saved. There is also a reduction in the machining cost per part. Parts may be held in any standard milling machine vise or chuck, clamped down to the table or held in specially designed jigs or fixtures.

The cutting speed is approximately 400 ft. per min. although where only very light cuts are necessary this speed may be greatly increased. The use of carbide-tipped cutters automatically increases this speed to about 1000 ft. per minute. Slow feeds are beneficial for producing smooth finishes. Milling cutters are to be kept extremely sharp at all times—in fact, honing the teeth to a very smooth cutting edge pays big dividends in smooth cuts obtainable and time saved in finishing.

Carving

The beautiful color combinations obtainable in cast resins are responsible for the increased demand for these materials in the manufacturing of jewelry and ornamental pieces. Skilled carvers have created marvels in costume jewelry by the use of steel cutters held in small chucks on flexible shaft equipment. These cutters are made in various sizes and shapes (the average being 1 in. in diameter) having from 20 to 36 teeth and are operated at approximately 2200 r.p.m. For very fine carving much smaller cutters are used to good advantage and are easily obtainable from dental supply houses. Cutters of this type having a $^{3}/_{32}$ in. diameter shank are more popular as they are more adaptable to regular dental hand pieces of about pencil size, and produce finer touch and action.

Grinding, sanding and shaping

Regular grinding equipment such as external, internal or surface grinders is used in *(Please turn to page 130)*

Stock molds

SHEET ONE HUNDRED TWENTY-THREE

Solenoid coil spools, cable clips, colorful handles for various purposes and different types of knobs are available without mold cost from stock molds, provided that restrictions on supplies of raw materials, etc., have not limited current production. For manufacturers' names and addresses, write Stock Mold Dept., Modern Plastics, Chanin Building, New York, giving item and sheet numbers

1450. Cable clips—three sizes: 1/8 in., 1/4 in. and 3/8 in.

1451. Ball handle, 1 in. diameter, 1 1/4 in. overall height. Shank: 7/16 in. diameter, 3/8 in. long. End of shank can be molded plain or with 10—32 brass inserts. Colors available

1452. Cupboard knob, 7/8 in. high, 1 1/8 in. wide at top, 3/16 in. threaded center opening. Available in any color

1453. Tapered knob, 3/4 in. diameter at top, 21/32 in. high. 6, 8 or 10—32 brass inserts. Available in any color

1454. Knurled knob with decorative top. 1/2 in. top diameter. 1/2 in. high. Aluminum rivet, or 6 or 8—32 brass inserts

1455. Utensil lid handle, 4 3/4 in. long, 3/4 in. wide. Brass threaded inserts 4 in. apart. Inside center height, 1 1/2 in.

1456. Drawer pull, 4 in. long, 5/8 in. wide. 3/4 in. inside center height. Threaded mounting centers 2 3/4 in. apart. Can be furnished with chrome bands inserted. Available in colors

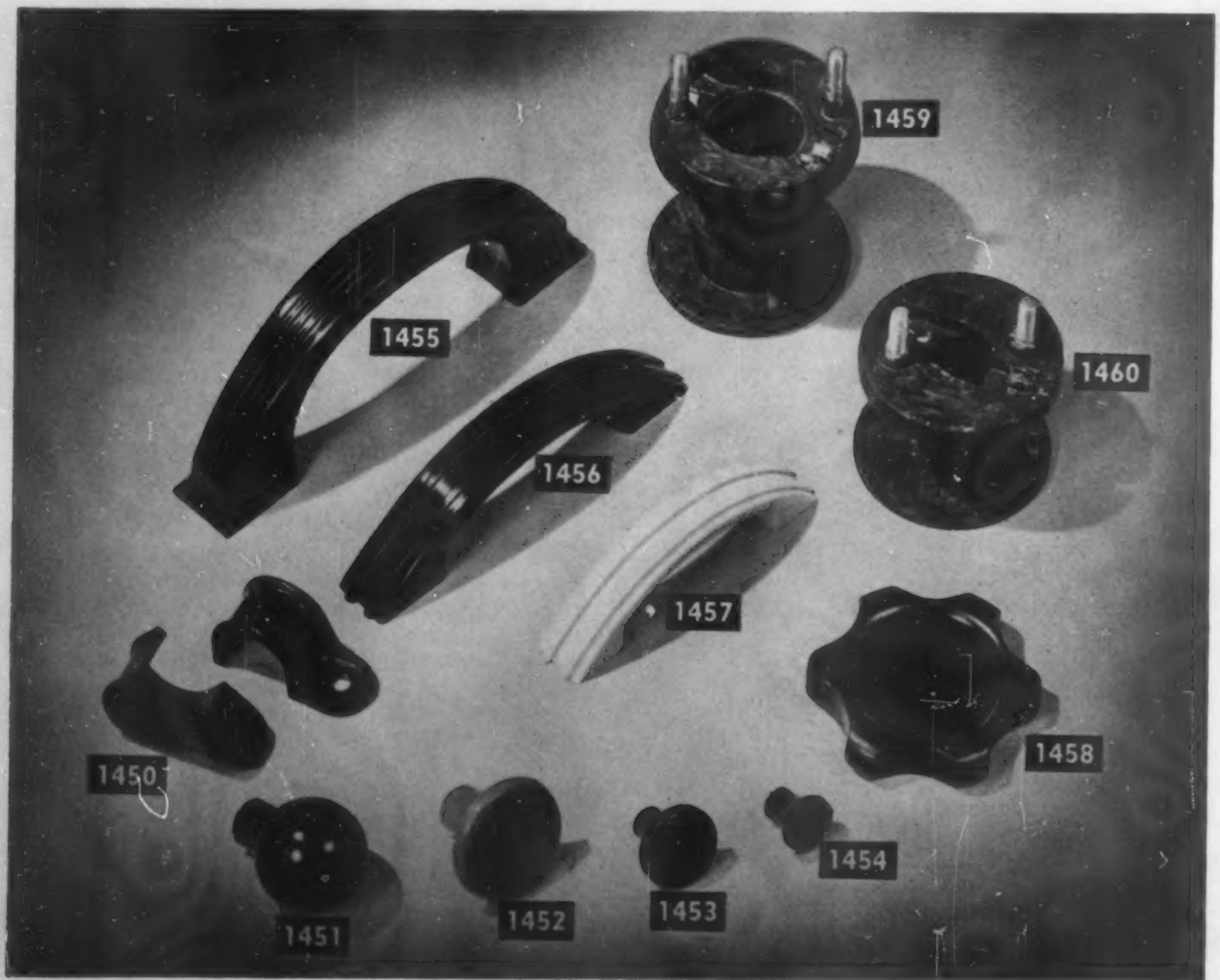
1457. Drawer pull, 3 1/8 in. long, 9/16 in. wide. Threaded openings 2 1/4 in. apart. Available in colors and with chrome bands

1458. 6-sided feed index handle, molded with 4 plain holes 11/16 in. apart. 2 1/8 in. diameter, 7/16 in. high

1459. Solenoid coil spool, with 10—32 brass inserts, cadmium plated and brass sleeve. 2 1/8 in. high. Opening 7/8 in.

1460. Spool as above without sleeve. 1 1/2 in. high; center opening 9/16 in.

Reprints of all Stock Mold pages to date are available to Stock Mold Service Subscribers



Mar resistance of plastics*

by Ladislav Boor†

INCREASING utilization of plastics as elements of structure and in the decorative field implies a constant expansion of knowledge concerning their basic physical properties. One of these groups of properties now under investigation by Subcommittee II on Hardness Properties of the A.S.T.M. Committee D-20 on Plastics has been given the general descriptive term "hardness." In the field of metals, the property of hardness has been associated with the concept of resistance to indentation, and methods of measuring this property are in general use.

In the field of plastics, it was soon found that the term "hardness" was used to describe many aspects of the behavior of plastics, such as:

(*a*) Resistance to compression and the variation of this resistance with temperature.

(*b*) Resistance to indentation.

(*c*) Resistance to wear, as occurs when a shaft revolves in a plastic bearing.

(*d*) Resistance to scratching by abrasive particles as might occur in a plastic table top or tray.

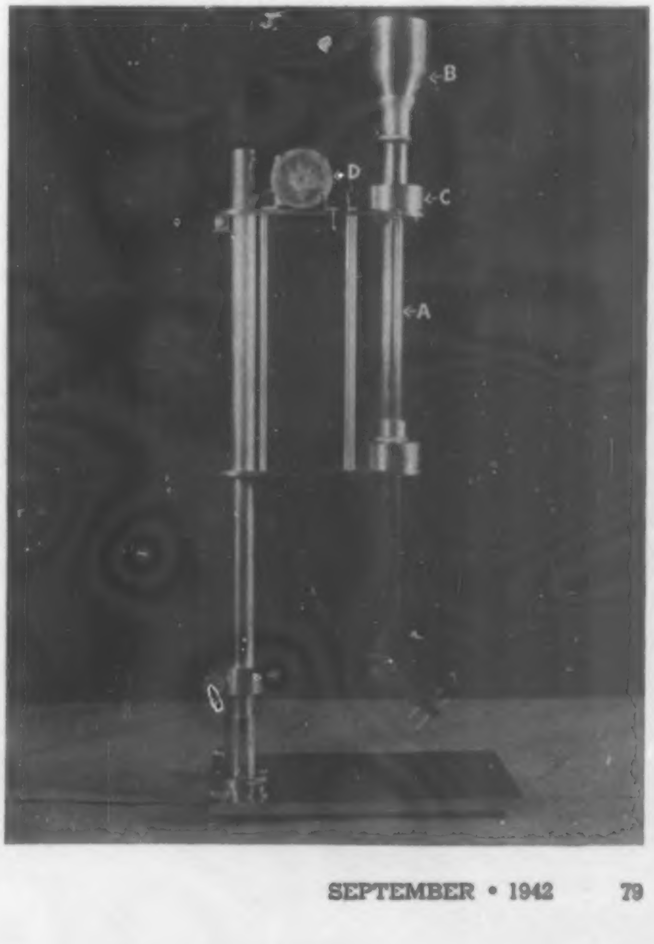
(*e*) Resistance to optical degradation by air-borne abrasive particles, as in a plastic windshield.

That determinations of hardness under each of the above conditions would not rate a series of plastics in the same order was soon recognized. In Kline and Axilrod's investigation of properties of transparent plastics for aircraft,[1] a comparison was made of hardness measured by different indentation methods with that found by the Bierbaum microcharacter.[2] Their conclusion at that time was: "It is therefore believed to be impractical to substitute the better known and more rapid indentation hardness measurement (Vickers) for scratch resistance data obtained with a sclerometer (Bierbaum)."

During the course of an investigation of scratch resistance of various thermosetting molding compounds and laminated decorative sheet materials, we attempted an evaluation of scratch hardness by means of the Bierbaum microcharacter. It was found that a rating on the basis of microhardness by the Bierbaum method did not agree too well with the results of service tests. This lack of correlation was partly due to the lack of precision inherent in the determination of microhardness of this type of material. The method requires measurement of a scratch made under standard conditions with an eyepiece scale in a microscope. The character of the furrows made in a brittle plastic surface layer makes it very difficult to judge the precise location of the edge of such a furrow to a high degree of certainty. For instance, in a group of samples, showing scratch widths of 29 to 36 μ, these values were accurate to about 4 μ, corresponding to a range of 7 to 12 points in microhardness values between 27.7 to 51.0. There is an additional error introduced by the elastic behavior of some of the plastics resulting in varying degrees of recovery at the edges of the furrow where the stresses are of a low order.

A method of measuring abrasion resistance of paint films has been described by Schuh and Kern[3] and is now under consideration as a tentative standard by the Society's Committee D-1 on Paint, Varnish, Lacquer and Related Products. In this method, a stream of abrasive is blown against a test surface and the amount of abrasive necessary to wear away a known thickness of paint film is determined. Some tests by this method on laminated plastics showed that the initial glossy surface of the material was removed in the first few seconds of the test, and further abrasion merely wore a de-

1—*Abrader*



* This paper was presented at the annual meeting of the American Society for Testing Materials in Atlantic City, N. J., on June 22, and is published here by permission of that Society. Details regarding the equipment and method of test, which are given in the A.S.T.M. method on page 84 of this issue, have been omitted from the text of the paper.

† Physicist, American Cyanamid Co., Stamford Research Laboratories, Stamford, Conn.

1 G. M. Kline and B. M. Axilrod, Study of Transparent Plastics for Use on Aircraft, Journal of Research, Nat. Bureau Standards *19*, 367–400 (October 1937) (*RP 1031*).

2 C. H. Bierbaum, A Study of Bearing Metals, Transactions, Am. Inst. Mining and Metallurgical Engrs. *69*, 972–89 (1923).

3 A. E. Schuh and E. W. Kern, Measurement of Abrasion Resistance, Industrial and Engineering Chemistry, Analytical Edition *3*, 72–6 (1931).

pression into the body of the sheet. Weighing the amount of material removed in a short time was unsatisfactory because of the small weight losses involved.

It was later found that dropping a granular abrasive from a height of about 25 in. gave a milder abrasive action and that increasing amounts of abrasive produced abraded spots progressively duller in appearance. This method is not new, having been in use by the author since about 1922 for evaluating abrasion resistance of cellulose nitrate film. Gardner[4] describes a similar method long used by his laboratory for testing paint and varnish films. More recently, the same principle has been used by Chalmers[5] for measuring the surface hardness of thin electroplated coatings, and its use on glass, plastics and paint films was suggested.

In the earliest work mentioned, the abrasion resistance was expressed in terms of a set of prepared standards which were matched visually against the unknowns. Gardner[4] suggested the use of a glossmeter for rating gloss degradation of paint films and Chalmers[5] described an instrument for measuring specular gloss.

An experimental glossmeter had been built by the Stamford Laboratory for evaluation of paint films and coated papers which, with some minor changes, was adapted for measuring gloss of the abraded test areas on plastics. The problem was to obtain a sufficiently large and uniformly abraded spot upon which the incident light beam of the glossmeter could be focussed, and the spatial distribution of the reflected image analyzed. A large abraded area implied an abrasive stream of considerable cross section—or a considerable quantity of abrasive if allowed to fall from a single opening—and the consequent interference of abrasive particles with each other. It was found that by allowing the abrasive to fall from a hopper with small openings at the bottom arranged in annular fashion and rotating the hopper slowly, a uniformly abraded spot about $^3/_4$ in. in diameter could be produced, and the rate of abrasive feed would be low enough to minimize the interference of abrasive particles with each other. The abrader as finally set up is shown in Fig. 1[6] and is described in detail on page 84.

Depending on the type of plastic under consideration, various methods of evaluating the optical degradation of the test areas may be used. For transparent plastics some type of haze meter, such as the Kline-Axilrod-Bowen instrument,[1] the American Optical Co.,[7] the Barnes sphere turbidimeter,[8] or any of the instruments described in the Proposed Tentative Method of Test for Measuring Photoelectrically the Haze of Transparent Plastics[9] may be used, and the results expressed in percentage of haze or percentage transmission against quantity of abrasive. Since most of our work has been concerned with opaque plastics, the simplified glossmeter previously referred to and shown in Fig. 2 was used. It is described in detail on page 84.

The particular aspect of hardness of which this test is a measure has been given the tentative designation "mar resistance."

Evaluation of typical materials

In the preliminary work, a large number of materials was tested, and typical curves are shown in Figs. 3 to 8. These results seemed encouraging enough to warrant further exploration. Accordingly, four laboratories agreed to carry out a series of cooperative tests. After one unsuccessful attempt it was apparent that the four glossmeters were not in agreement with one another. A series of reference standards was then prepared,[10] by grinding plate glass to varying degrees of surface roughness, calibrating them on one instrument, and distributing them among the four laboratories. The proper adjustments were then made on each of the instruments, and the final comparison of calibration is given in Table I. It is our opinion that this agreement between instruments of different makes using different photocells and electrical measuring equipment is as good as can be expected. Higher degrees of precision would result from the construction of all instruments by the same company, but this must be left for the future.

A series of plastic sheet materials was then distributed among three of the laboratories, each equipped with its own abrader and glossmeter. The comparisons were made on the basis of the following amounts of abrasive: 400, 800, 1200 and 1600 gm. Table II shows the values obtained with the average of residual gloss at the four amounts of abrasive.

(*Please turn to page 81*)

[4] Henry A. Gardner, "Physical and Chemical Examination of Paints, Varnishes, Lacquers and Colors," Ninth Edition, p. 128 (1939).

[5] Bruce Chalmers, Surface Hardness of Metals, Journal Inst. of Metals (British) *67*, 295–314 (1941).

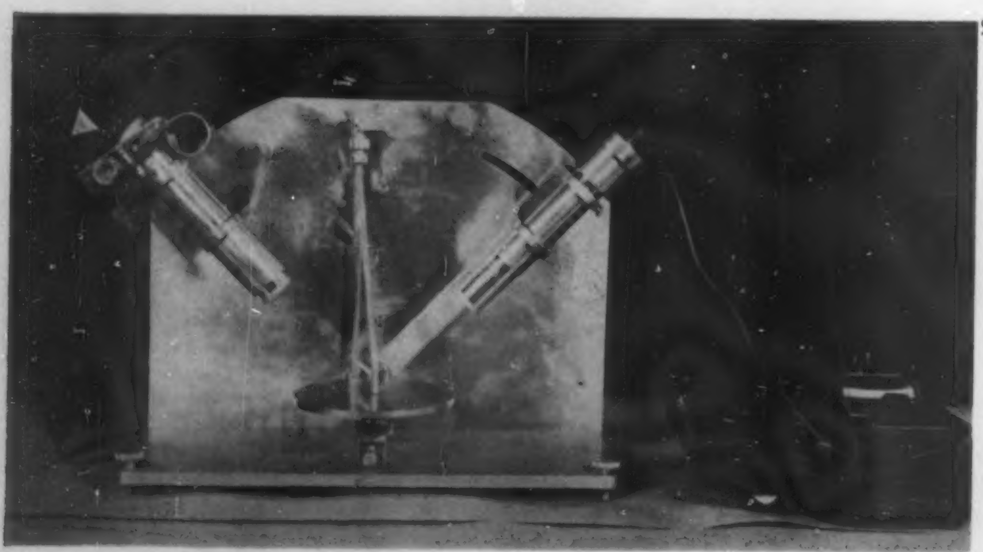
[6] The abrader, Fig. 1, and glossmeter, Fig. 2, were designed and constructed under the direction of B. J. Dennison of the Pittsburgh Plate Glass Co., Creighton, Pa. Working drawings are to be available from A.S.T.M. headquarters.

[7] H. R. Moulton, Proposed Method of Haze Measurement, Report to Subcommittee IV on Optical Properties of A.S.T.M. Committee D-20 on Plastics.

[8] Barnes turbidimeter now under development.

[9] Report of Committee D-20 on Plastics, Preprint No. 75, Forty-fifth Annual Meeting, Am. Soc. Testing Mats., June 22–26, 1942, MODERN PLASTICS, *19*, 80, 136 (Aug. 1942).

[10] These were prepared through the courtesy of B. J. Dennison of the Pittsburgh Plate Glass Co.



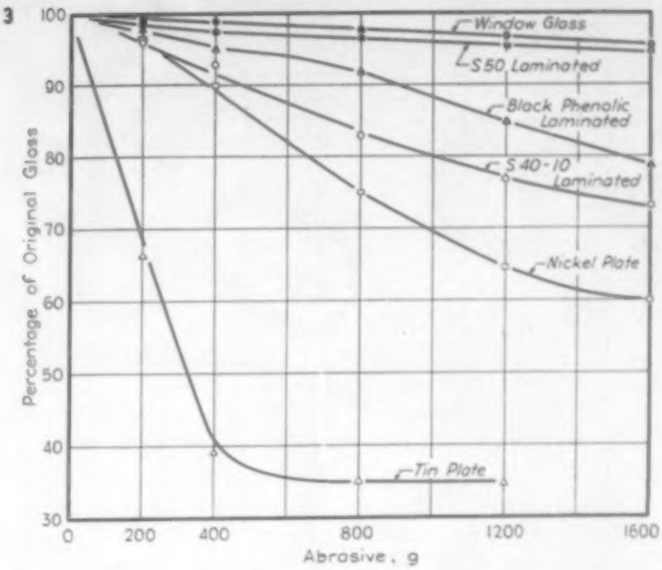
2

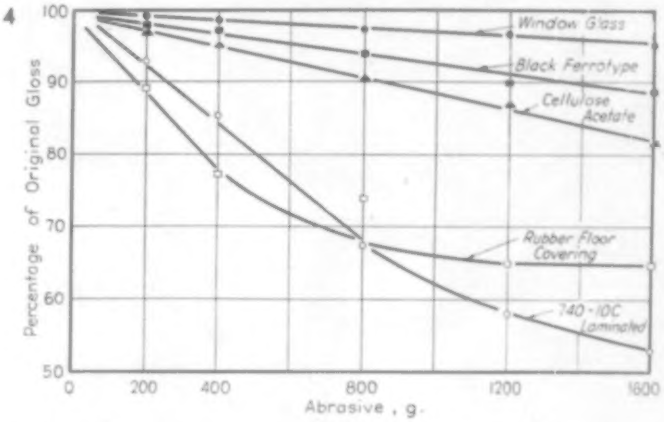
2—A simplified glossmeter used for measuring gloss of abraded test spots on plastics. It consists of a light source which uses a photoelectric cell as the active element, and a galvanometer

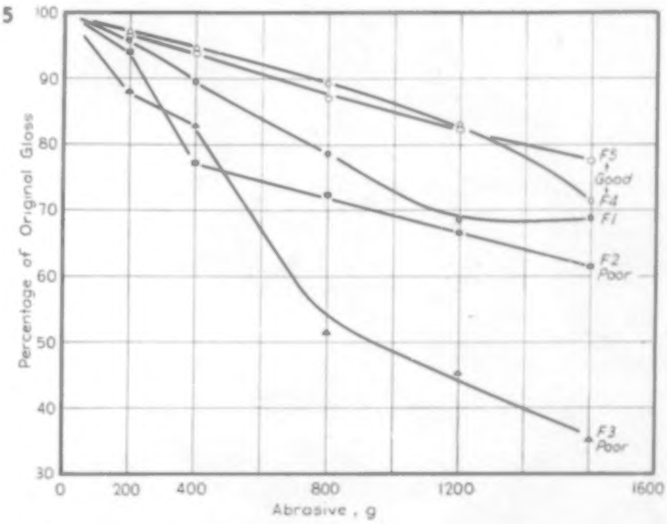
TABLE I.—COMPARISON OF CALIBRATION TESTS WITH DIFFERENT GLOSSMETERS

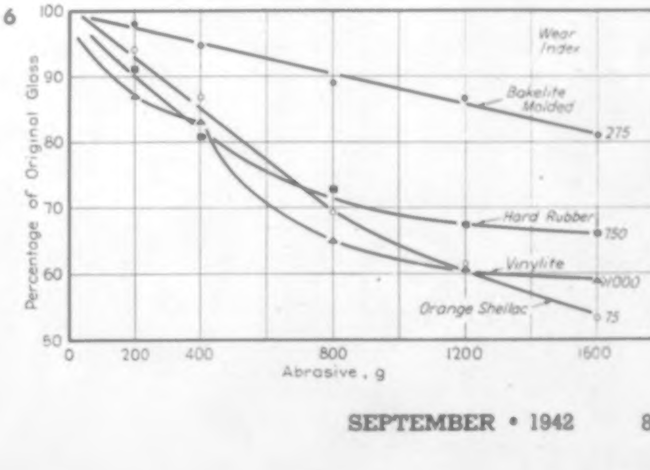
Standard sample	*Gloss, percent*[a]				*Difference from Laboratory A*
	Laboratory A	*Laboratory B*	*Laboratory C*	*Laboratory D*	
No. 1 *a*	99.3	99.4	....	....	+0.1
b	80.8	79.1	....	....	−1.7
c	83.0	81.4	....	....	−1.6
d	77.0	80.0	....	....	+3.0
e	45.0	47.0	....	....	+2.0
No. 3 *a*	99.3	99.4	....	....	+0.1
b	90.5	90.0	....	....	−0.5
c	84.8	85.0	....	....	+0.2
d	79.5	78.7	....	....	−0.8
e	46.8	46.8	....	....	0
No. 4 *a*	99.3	99.3	....	....	0
b	72.0	73.6	....	....	+1.6
c	81.8	80.6	....	....	−1.2
d	76.0	74.5	....	....	−1.5
e	46.3	46.7	....	....	+0.4
No. 6 *a*	99.3	99.3	....	....	0
b	89.0	90.0	....	....	+1.0
c	76.0	79.3	....	....	+3.3
d	73.4	73.5	....	....	+0.1
e	45.5	46.7	....	....	+1.2
No. 5 *a*	99.3	....	99.8	....	+0.5
b	89.5	....	88.0	....	−0.5
c	82.0	....	79.9	....	−2.1
d	73.8	....	73.6	....	−0.2
e	45.0	....	47.1	....	+2.1
No. 2 *a*	99.3	....	....	99.5	+0.2
b	91.0	....	....	93.3	+2.3
c	86.0	....	....	88.6	+2.6
d	78.8	....	....	79.5	+0.7
e	46.7	....	....	49.2	+2.5
No. 7 *a*	99.3	....	....	....	....
b	90.5	....	....	....	....
c	82.0	....	....	....	....
d	75.8	....	....	....	....
e	47.4	....	....	....	....
No. 8 *a*	99.3	....	....	....	....
b	87.0	....	....	....	....
c	79.8	....	....	....	....
d	72.5	....	....	....	....
e	46.7	....	....	....	....

[a] Laboratory A = American Cyanamid Co., Stamford Laboratory; original laboratory instruments.
Laboratory B = Pittsburgh Plate Glass Co., Creighton, Pa.; abrader and glossmeter designed and built by themselves.
Laboratory C = Brooklyn Navy Yard, Brooklyn, N. Y.; abrader and glossmeter built according to Pittsburgh Plate Glass design.
Laboratory D = Brooklyn Polytechnical Institute, Brooklyn, N. Y.; laboratory instruments built by themselves.

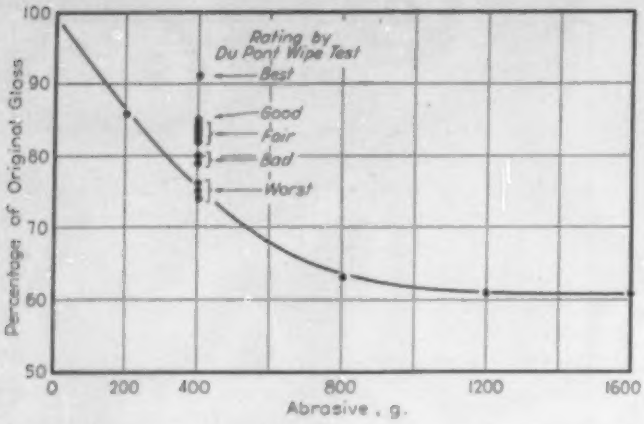
3


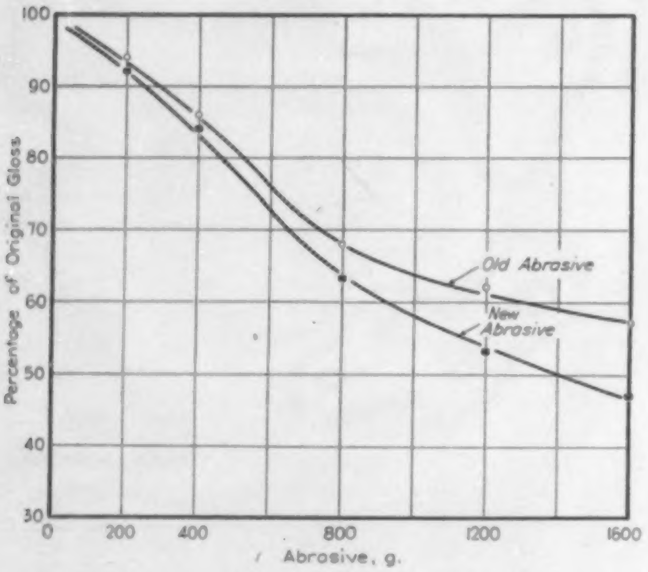
4


5


6


3—Marresistance tests on window glass, melamine-urea resin surface laminated (S50), black phenolic paper base laminated, plasticized melamine-urea laminated (S40-10), nickel plate and tin plate. 4—Mar resistance tests on black ferrotype plate, cellulose acetate sheet, a plasticized melamine-urea laminated (740-10C) and a rubber floor covering compound. 5—Marresistance tests on a group of paper-base laminated materials with their general classification based on service tests. 6—Mar resistance tests on four materials used in telephone equipment with their wear indices based on service tests





7—Mar resistance tests on a variety of methacrylate sheet materials with their ratings on the basis of a "wipe test."
8—Comparative effect of using fresh and old (used for circa. 400 runs) abrasive in testing the same material

TABLE II.—GLOSS VALUES OBSERVED IN ABRASION TESTS ON VARIOUS PLASTICS

Laboratory	Material[a]	Percentage of original gloss: 400 gm. abrasive	800 gm. abrasive	1200 gm. abrasive	1600 gm. abrasive	Avg.
B	Formica No. 1	90.3	80.5	72.9	65.0	77.2
C		87.8	80.0	70.8	66.0	76.2
A		89.0	79.5	73.1	67.3	77.2
B	Formica No. 2	69.0	49.9	36.8	26.8	45.6
C		75.6	55.7	42.2	41.2	53.7
A		76.1	62.5	51.8	45.4	59.0
B	Formica No. 3	83.7	64.7	51.1	43.8	60.8
C		80.2	62.3	47.8	34.5	56.2
A		78.8	62.4	53.1	50.6	61.2
B	Polystyrene	45.9	27.8	29.1	24.5	31.8
C		43.1	22.1	20.5	17.9	25.9
A		50.8	39.1	33.9	33.9	39.4
B	Vinylite	76.6	59.2	53.5	48.5	59.5
C		75.4	58.7	45.2	43.4	55.7
A		74.1	65.4	62.0	59.1	65.2
B	Cellulose acetate	84.6	74.3	63.9	60.2	70.8
C		81.7	68.7	59.4	51.2	65.3
A		82.7	72.6	67.4	63.1	71.5
B	Methacrylate	81.4	61.1	47.6	46.7	59.2
C		77.4	58.5	39.6	27.2	50.7
A		74.1	60.7	56.1	53.5	61.1

[a] Formica No. 1—Laminated sheet material, walnut color, urea-melamine resin surface.
Formica No. 2—Laminated sheet material, light green color, urea-thiourea resin surface.
Formica No. 3—Laminated sheet material, mahogany color, phenolformaldehyde resin surface.
Formica Nos. 1, 2 and 3 obtained from J. D. Pitzer, Formica Insulation Co., Cincinnati, Ohio.
Polystyrene—Transparent amber injection molded sheet No. 141-A7014-A. Obtained from H. K. Nason, Monsanto Chemical Co., Springfield, Mass.
Vinylite—Opaque dark blue sheet VS 3300. Obtained from M. C. Reed, Vinylite Division, National Carbon Co., Cleveland, Ohio.
Cellulose Acetate—colorless transparent sheet. Obtained from E. Schweizer, The Celluloid Co., Newark, N. J.
Methacrylate—Colorless transparent sheet. Obtained from E. I. du Pont de Nemours & Co., Inc., Arlington, N. J.

Interpretation of data

These data may be interpreted in two general ways. Recognizing the fact that all plastic materials are not uniformly hard as the surface is penetrated, we might compare them on the basis of:

(*a*) The average area under the curve of percentage gloss plotted against amount of abrasive up to 1600 gm. of abrasive.

(*b*) The relative percentage gloss at a constant small amount of abrasive (400 gm.).

Table III gives these comparative values. It appears that the two materials Formica No. 1 and cellulose acetate are rated first and second, and polystyrene is rated seventh by all laboratories. The other four materials are closely grouped between these two extremes, by all laboratories.

Table IV, based on the averages of all three laboratories on each material, gives the relative abrasion resistance of the group, rated at average for the full 1600-gm. test and at 400 gm. of abrasive. For comparison the ratings by two methods of scratch hardness are included. Although the two scratch hardness tests rate the materials in exactly the same order, this order differs from the rating by the mar resistance test.

TABLE III.—COMPARATIVE MAR RESISTANCE RATINGS FOR VARIOUS PLASTICS

	Laboratory A				Laboratory B				Laboratory C			
	Average	*Rating*	*400 gm.*	*Rating*	*Average*	*Rating*	*400 gm.*	*Rating*	*Average*	*Rating*	*400 gm.*	*Rating*
Formica No. 1	77.2	1	89.0	1	77.2	1	90.3	1	76.2	1	87.8	1
Cellulose acetate	71.5	2	82.7	2	70.8	2	84.6	2	65.3	2	81.7	2
Vinylite	65.2	3	74.1	5	59.5	4	76.6	5	55.7	4	75.4	6
Formica No. 3	61.2	4	78.8	3	60.8	3	83.7	3	56.2	3	80.2	3
Methacrylate	61.1	5	74.1	6	59.2	5	81.4	4	50.7	6	77.4	4
Formica No. 2	59.0	6	76.1	4	45.6	6	69.0	6	53.7	5	75.6	5
Polystyrene	39.4	7	50.8	7	31.8	7	45.9	7	25.9	7	43.1	7

TABLE IV.—COMPARISON OF MAR RESISTANCE AND SCRATCH HARDNESS VALUES FOR VARIOUS PLASTICS

	Mar resistance				Scratch hardness			
	Average	*Rating*	*400 gm.*	*Rating*	*Bierbaum*[a]	*Rating*	*Olsen*[b]	*Rating*
Formica No. 1	76.9	1	89.0	1	30.9	2	2.27	2
Cellulose acetate	69.2	2	82.7	2	12.2	6	0.89	6
Vinylite	60.1	3	75.4	5	12.2	7	0.70	7
Formica No. 3	59.4	4	80.9	3	21.4	3	1.88	3
Methacrylate	57.0	5	77.6	4	21.4	4	1.88	4
Formica No. 2	52.8	6	73.6	6	47.6	1	2.81	1
Polystyrene	32.7	7	46.6	7	15.8	5	1.35	5

[a] Bierbaum Scratch Hardness tests made with microcharacter[3].
[b] Olsen Scratch Test made on an instrument now under development. Data from report to Subcommittee II of Committee D-20 by B. L. Lewis, Sept. 26, 1941.

It can be seen that continued abrasion will reduce the gloss of any plastic until its surface approaches a nearly constant matte condition; hence small differences in the rate of degradation at the beginning of the test are masked by the approach to a constant value with large amounts of abrasion. It is possible that the relative gloss at a mild degree of abrasion, such as 400 gm., may be a sufficiently significant measure of mar resistance. A test at one quantity is shorter than the complete series, where five different amounts are used, and several check runs at 400 gm. should give a representative value for the plastic under test.

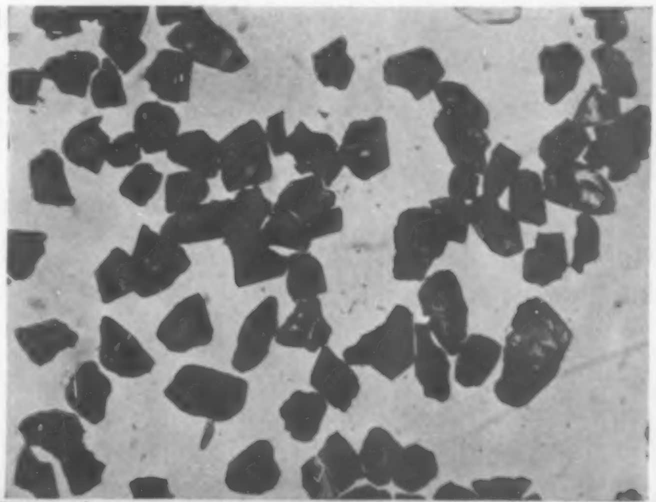
We wish to emphasize at this point that each of the materials tested represents only one of a wide variety of formulations and range of properties which can be imparted to any one of the group; hence the ratings of scratch and mar resistance as shown cannot pretend to represent a final and absolute rating of the materials listed.

Figures 9 and 10 show the appearance of typical test specimens after abrasion. Figure 11 shows photomicrograph of No. 80 carborundum.

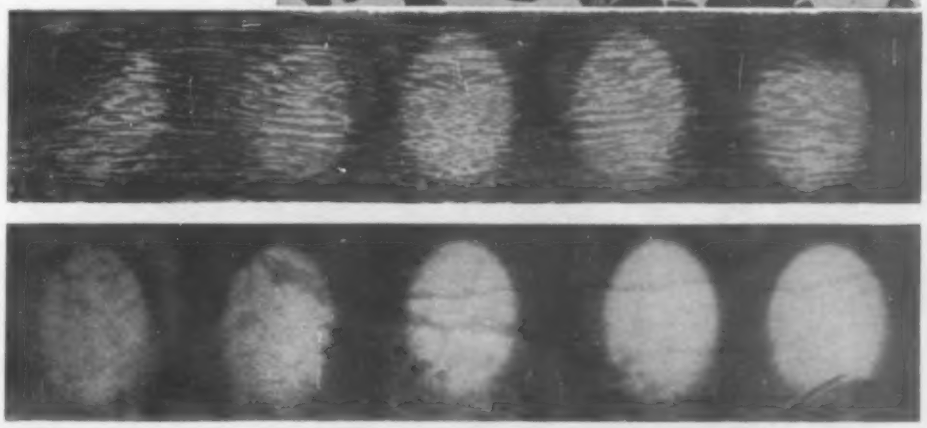
Acknowledgments

We wish to express our indebtedness to R. B. Barnes, C. R. Stock and J. R. Schneider of the Stamford Laboratories staff for their assistance in the preparation of this paper; to B. J. Dennison of the Pittsburgh Plate Glass Co. for his share in the design of the abrader and glossmeter illustrated, and his help in the preparation of gloss standards; to the laboratories whose test work provided the basis for most of our data; and to the members of Committee D-20 for materials tested.

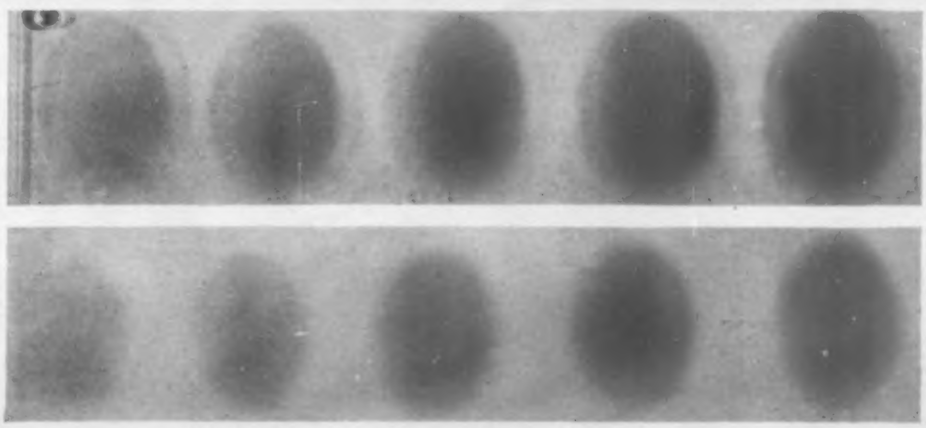
11



9



10



9—Abraded test areas on typical laminated plastics. 10—Abraded test areas on typical transparent plastics. 11—Photomicrograph of No. 80 carborundum (X50)

ASTM test: mar resistance of plastics*

Scope

1. This method of test is designed to measure the resistance of glossy surfaces to abrasive action. Since measurement of progressive optical deterioration of a glossy surface is involved, such materials as molded and laminated plastics, paint and lacquer films, and plated coatings may be evaluated by this method. The test consists essentially of two steps as follows:

(*1*) The production of a series of abraded spots on the surface of the test specimen, made by dropping increasing amounts of abrasive through a tube of fixed length, and

(*2*) The measurement of the gloss of these abraded spots by an optical method and comparison with the original gloss.

NOTE: Since this method is intended for rating relative decrease in gloss, obviously only materials having originally high specular reflectance can be measured.

Apparatus

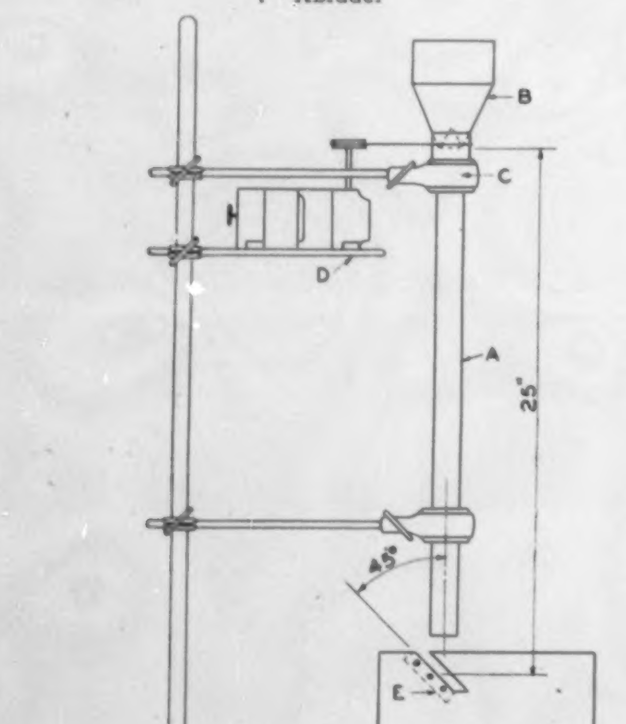
2. The apparatus shall consist of the following:[1]

(*a*) *Abrader.* An abrader, shown in Fig. 1, consisting of the following:

(*1*) *Glass tube.* A glass tube (*A*, Fig. 1) supported vertically through which the abrasive is dropped on a test specimen that is supported at an angle of 45° to the axis of the tube. Tube shall conform to dimensions shown in Fig. 2.

(*2*) *Hopper.* A hopper (*B*, Fig. 1) to distribute the feed of the abrasive in order to produce on the specimen an abraded spot nearly uniform in appearance over an area about $^3/_4$ in. in diameter. The hopper shall be rotated at about 7 r.p.m. and the abrasive fed from the hopper at a rate of about 200 to 250 gm. per min. The details of construction of the hopper are shown in Fig. 2. It may be formed from thin sheet metal with soldered seams. It shall have a double conical bottom with 6 holes 0.070 in. in diameter arranged in a circle $^5/_8$ in. in diameter at the bottom edge, and 1 hole 0.070 in. in diameter at the apex of the middle cone. The inside of the hopper should be smooth and highly polished.

1—*Abrader*



(*3*) *Ball bearing.* A ball bearing (*C*, Figs. 1 and 2) $2^1/_4$ in. in outside diameter and $1^1/_4$ in. in inside diameter, with sealed balls. The outside ring of the bearing shall be rigidly held in position.

(*4*) *Brass or copper tube.* A brass or copper tube (see Fig. 2) about $1^1/_2$ in. in length fitted tightly into the bearing. The inside diameter shall be slightly over 1 in. to permit the top of glass tube *A* to extend up into it just below the lower edge of the hopper. To the tube shall be soldered 4 supports for holding the hopper in position. The projecting portion of the tube serves as a pulley to rotate the hopper assembly.

(*5*) *Electric motor.* A small electric motor[2] with built-in reducing gears for rotating the hopper assembly at a speed of about 7 r.p.m.

(*6*) *Receptacle for abrasive.* A receptacle (*F*, Fig. 1) about 8 by 8 by 8 in. to receive the abrasive. A 5-gal. can cut down to a height of 8 in. will be satisfactory. The receptacle shall be slotted on two sides at an angle of 45° as shown in Fig. 1 to permit sliding sheet specimens past bottom of glass tube.

(*7*) *Support for test specimen.* A plywood board (*E*, Fig. 1), with spring clips to hold the test specimen, mounted in the receptacle at an angle of 45° to the axis of the tube and directly under the tube.

(*8*) *Abrasive.* No. 80 carborundum or equivalent abrasive.

NOTE: It has been found that continued use of the same batch of abrasive gradually improves the values of abrasion resistance of a given material, possibly due to the breaking up of particles of the abrasive or by dulling their sharp cutting edges. An arbitrary limit of 50 tests is recommended for a given lot of abrasive, after which it should be discarded. It is also advisable to keep the abrasive well screened through a No. 60 (250-micron) sieve to remove extraneous matter such as lint, hairs, wood splinters, etc., and on a No. 120 (125-micron) sieve to remove the fine, broken-down particles and dust.

(*b*) *Glossmeter.* A light source and simplified form of glossmeter using a photoelectric cell as the active element and a galvanometer, as shown in Fig. 3, conforming to the following requirements:

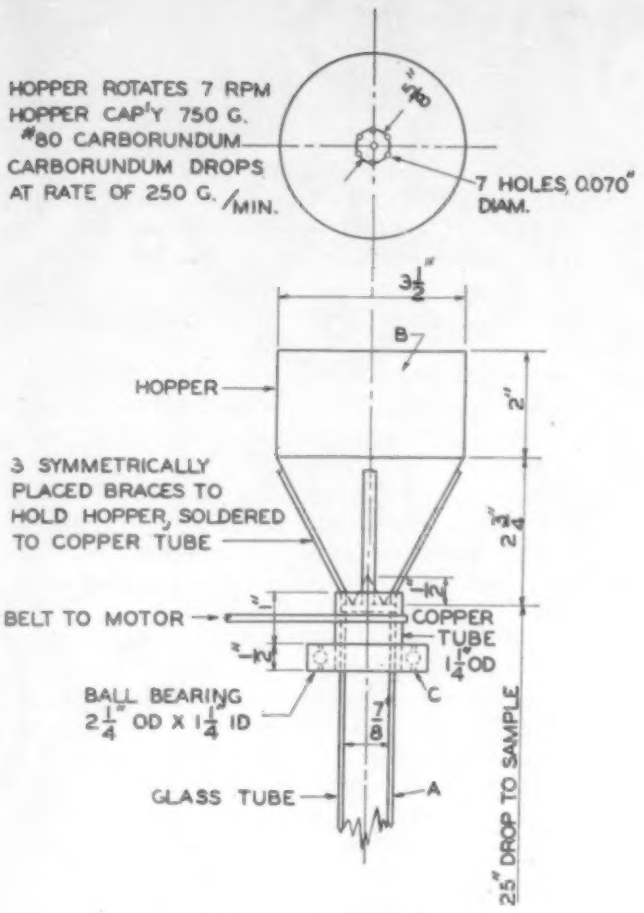
(*1*) *Light projector.* A model "M" SVE[3] projector to act as a light source. An extension tube made to permit the lens to form an image at a short distance shall be used. The size of the test spot used is determined by several circular holes ranging from $^1/_8$ to $^3/_8$ in. in diameter punched in a piece of blackened 35-mm. film loaded into the projector. A diaphragm may be added to the front of the projector lens to regulate the quantity of light, independently of the size of the

* This tentative method of test for Mar Resistance of Plastics, A.S.T.M. designation D 673–42 T, is published here by permission of the American Society for Testing Materials.

[1] Complete working drawings for this apparatus will be obtainable at a nominal charge from the Headquarters of the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa.

[2] A suitable electric motor is the No. 952W/11 r.p.m. of the Speedway Mfg. Co., 1834 South 52nd Ave., Cicero, Ill.

[3] The Society for Visual Education, 100 E. Ohio St., Chicago, Ill.



2—*Details of hopper assembly*

test spot. This may be a microscope condenser diaphragm with a $1^1/_4$-in. opening for fitting over the projector lens, or a series of caps with holes of various diameters in steps of $\sqrt{2}$ may be used. The projector may be permanently mounted at an angle of 45° and so that the distance from the lens surface to the perforated film is about 12 inches. A voltage regulator on the line leading to the projector is desirable but not essential if the voltage fluctuations are not of too great an amplitude or if they are not of short duration.

(2) *Receptor system.* A receptor system consisting of a lens, photoelectric cell and galvanometer. A lens about $1^1/_4$ to $1^1/_2$ in. in diameter having a 4- to 5-in. focal length (a duplicate of the projector lens may be used) shall be used to pick up the reflected beam and converge it sufficiently to impinge on the sensitive surface of the photoelectric cell. The cell may be of any type having a linear current intensity relation.[4] The galvanometer[4] shall be used for indicating the current flow in the receptor circuit. The receptor system may be fastened to a hinged arm with its center in the plane of the test specimen and in line with the center of the illuminated spot, and shall have freedom of motion from the specular position at an angle of 45° to the plane of the specimen to the off-specular position at an angle of 60° to the plane of the specimen. When the glossmeter is assembled and a mirror placed in the position to be occupied by a test specimen, the circular incident light beam from the projector should be seen entering the receptor lens at the specular angle of 45°. When the receptor is tilted upward 15° to the off-specular angle of 60°, the specular beam shall just miss the receptor lens. The active surface of the photoelectric cell shall be masked to permit only the specularly reflected image of the spot to impinge on the cell.

[4] Any barrier layer cell having an active surface about 1 in. in diameter may be used. A suitable cell is the No. 732 Electrocell of Photovolt Corp., 95 Madison Ave., New York, N. Y., and other suitable cells are manufactured by the General Electric Co., Schenectady, N. Y., and the Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa. The galvanometer may be the General Electric No. 32C 249G25 with built in shunts with ranges of 10-5-2-1 or a similar instrument having an internal resistance of 300 ohms or less.

Other suitable instruments that include both photoelectric cell and galvanometer are the Photrix Universal Photometer, model A, the Photovolt Corp.; and the Weston model 603 Illumination Meter with single No. 594 cell, the Weston Electrical Instrument Corp., Newark, N. J.

NOTE: The glossmeter described may be used to measure gloss on any type of surface, transparent or opaque. For testing of transparent sheets, some form of hazemeter or densitometer may also be used.

Test specimen

3. The test specimen shall consist of any material with a flat surface at least 2 by 2 in. in area for each determination. A sheet 2 by 10 in. will be sufficient for five tests.

Procedure

4. (*a*) Five abraded spots shall be made on each test specimen (Note), and each succeeding spot shall be produced by using a larger quantity of abrasive than that used for the preceding one. The following amounts of abrasive are recommended:

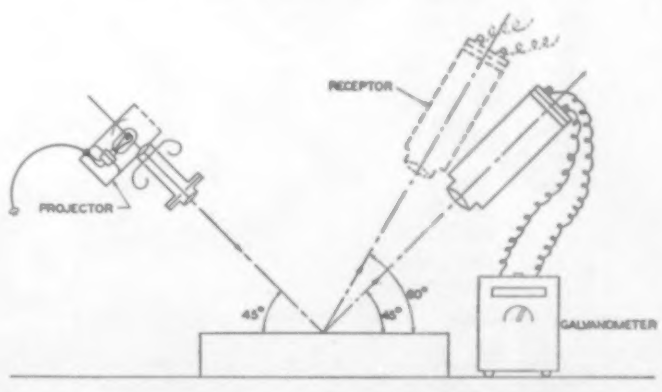
Spot	*Abrasive, gm.*
No. 1	200
No. 2	400
No. 3	800
No. 4	1200
No. 5	1600

NOTE: For a quick test at a mild degree of abrasive action, the results obtained using 200 or 400 g. of abrasive may give sufficient information.

(*b*) *Abrading test specimens.* The test specimen shall be clipped to the supporting board, the hopper started rotating and the proper amount of abrasive poured into the hopper. When all of the abrasive has passed through the glass tube, the specimen shall be moved to another position, and the next succeeding amount of abrasive poured into the hopper to produce another abraded spot. In this manner, five abraded spots shall be produced, each by the respective amount of abrasive. It is recommended that a mild air blast be used to remove excess abrasive adhering to the surface of the specimen after the abraded spots have been produced.

(*c*) *Measurement of gloss.* The gloss of the abraded test spots shall be measured by means of the glossmeter and compared with the original gloss of the test specimen. The principle of operation of the glossmeter in measuring the gloss is based upon the following optical behavior of plane surfaces as shown in Fig. 4. A beam (*Please turn to page 126*)

3—*Distribution of reflected light*



Plastics statistics for 1941

THE United States Tariff Commission has made available preliminary statistics of production and sales in the United States of synthetic organic chemicals during 1941. To avoid disclosure of any information which might aid the enemy, statistics concerning coal-tar crudes, coal-tar intermediates (except totals) and other specific items, such as plasticizers and various solvents, are omitted for 1941. A complete printed report is to be issued when permissible.

The increased activity in production and sales of synthetic organic chemicals was due to an increase in both civilian and military consumption. Military demands were confined to relatively few individual items. Not many synthetic organic chemicals were under general preference orders, limitation orders, or under price control in 1941. The total output, however, of some finished and intermediate products was diminished in 1941 by a shortage of raw materials.

The total production of synthetic resins in 1941 was about 438,000,000 pounds, an increase of 58 percent over 1940. The output of coal-tar resins in 1941 was about 334,000,000 pounds, or approximately 54 percent greater than in 1940. The output of non-coal-tar resins in 1941 was about 104,000,000 pounds or approximately 75 percent greater than in 1940. Maleic anhydride resins, formerly classified as coal-tar resins, are included with the non-coal-tar group this year. Their production volume was 46 percent higher than in 1940. Alkyd resins of the phthalic anhydride type were up 40 percent in production volume. The output of resins derived from cresols or cresylic acid nearly doubled and those made from phenol and cresols increased 65 percent. A considerable portion of these increases was due undoubtedly to the replacement of scarce metals by these plastics for many purposes. The production of phenolic resins of the casting type was approximately the same as in 1940: namely, about 6,700,000 pounds. The amount of urea resins made was close to 35,000,000 pounds, an increase of about 63 percent. The complete data for 1941 and the comparative totals for the three preceding years are given in Table I.

The miscellaneous synthetic resins of coal-tar origin grouped under the designation "all other" include, among others, resins derived from coumarone and indene, hydrocarbons, styrene and sulfonamides. In the non-coal-tar miscellaneous resins are included those derived from abietic acid, acrylic acid, adipic acid, ketones, melamine, petroleum, polyamides, succinic acid, terpenes and various vinyl derivatives.

Statistics on the production and sales of plasticizers during 1941 are presented in Table II. The output of these chemicals was also increased over 1940 by about 65 percent. The percentage increase was somewhat greater for the plasticizers derived from coal-tar sources. The only plasticizer for which separate figures were reported is dibutyl tartrate, derived from non-coal-tar sources. Production of this chemical increased about 15 percent during 1941.

Statistics of the Bureau of the Census for the production of cellulose plastics during 1941 are recorded in Table III. The total output reached a new high of over 53,000,000 pounds, the 50 percent gain over 1940 being of the same order as that for the synthetic resin group. The production of cellulose nitrate plastic was up about 40 percent. Sheet, rod and tube manufacture from cellulose acetate

TABLE I.—UNITED STATES PRODUCTION AND SALES OF CERTAIN SYNTHETIC RESINS IN 1941

Product	Production, pounds	Sales: Pounds	Sales: Value	Sales: Unit value
(A) Resins derived from coal-tar: Total	334,200,666	255,721,097	$66,619,834	$0.26
Alkyd resins: Total				
Maleic anhydride[1]				
Phthalic anhydride	128,362,566	63,372,053	12,475,807	.20
Derived from tar acids				
Cresols or cresylic acid	22,717,921	17,312,666	6,259,363	.36
Phenol:				
For casting	6,661,760	7,018,797	3,436,711	.49
For molding	41,333,155	40,941,741	12,978,878	.32
For other uses	50,645,064	49,484,635	9,209,865	.19
Phenols and cresols	34,959,533	34,974,799	17,331,685	.50
Xylenols	309,662	321,780	57,726	.18
All other	49,211,005	42,294,626	4,869,799	.12
(B) Resins from non-coal-tar sources: Total	103,599,021	92,586,373	50,636,117	.55
Maleic anhydride	9,473,995	8,357,314	1,117,625	.13
Urea	34,848,718	33,370,720	10,797,582	.32
All other	59,276,308	50,858,339	38,720,910	.76
Total for resins, 1941	437,799,687	348,307,470	117,255,951	.34
Total for resins, 1940	276,814,363	201,099,650	59,368,339	.30
Total for resins, 1939	213,027,548	163,296,637	39,011,486	.24
Total for resins reported,[2] 1938	130,358,652	101,828,188	22,871,974	.22

[1] Reclassified under non-coal-tar resins.
[2] Does not include resins from adipic acid, coumarone and indene, hydrocarbons, styrene, succinic acid and sulfonamides.

was down about 30 percent. This can be attributed to a decline in the use of this material in sheet form for the preparation of safety glass and to the exclusion of figures for such material from the reported data. However, production of cellulose acetate molding composition was practically doubled during 1941. This resulted in a net gain for cellulose acetate plastic of about 55 percent during 1941. The production figures for the cellulose plastics during the first four months of 1942 indicate that new production records will again be established during the current year.

Production data for ethyl cellulose and cellulose acetate butyrate plastics have not been made available. Comparative data for the production of synthetic resins and cellulose plastics in the United States for the years prior to 1938 will be found in Modern Plastics for October 1937, page 6, and October 1938, page 11.

Table II.—United States Production and Sales of Plasticizers in 1941

Product	Production, pounds	Sales		
		Pounds	Value	Unit value
Plasticizers from coal-tar sources: Total	48,830,257	44,799,768	$10,186,523	$0.23
Plasticizers from non-coal-tar sources: Total	12,118,032	10,274,328	3,966,596	.39
Dibutyl tartrate	32,342	34,673	21,150	.61
Total for plasticizers, 1941	60,948,289	55,074,096	14,153,119	.26
Total for plasticizers, 1940	36,860,409	28,298,930	7,013,579	.25
Total for plasticizers, 1939	29,870,759	24,369,075	5,763,427	.24

Table III.—Cellulose Plastic Products

These statistics on production of cellulose plastic products were released by Director J. C. Capt, Bureau of the Census, Department of Commerce. The data for sheets, rods and tubes made of cellulose nitrate were reported by 10 manufacturers. The production of cellulose acetate sheets, rods and tubes was reported by 5 manufacturers. The data on cellulose acetate molding composition were reported by 9 manufacturers for the month of April, 1942, 8 for the months January through March 1942 and for 1941 and 1940, 7 manufacturers for January 1939, 8 manufacturers for February to December 1939, and 6 manufacturers for the year 1938. The data represent practically the entire industry.[1]

Year and month	Cellulose Nitrate				Cellulose Acetate			Total production of cellulose plastics
	Production of sheets	Production of rods	Production of tubes	Total production	Production of sheets, rods and tubes[2]	Production of molding compositions	Total production	
1941	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*
January	719,336	349,402	97,794	1,166,532	616,525	1,631,502	2,248,027	3,414,559
February	720,173	314,560	;97,399	1,132,132	343,605	1,878,807	2,222,412	3,354,544
March	844,819	363,429	99,345	1,307,593	464,601	2,231,630	2,696,231	4,003,824
April	927,399	356,179	136,048	1,419,626	402,492	2,254,895	2,657,387	4,077,013
May	935,239	306,749	130,457	1,372,445	524,393	2,319,133	2,843,526	4,215,971
June	913,725	332,433	140,482	1,386,640	512,506	2,457,497	2,970,003	4,356,643
July	851,752	291,167	166,022	1,308,941	507,081	2,467,166	2,974,247	4,283,188
August	973,085	315,778	148,280	1,437,143	572,695	2,670,007	3,242,702	4,679,845
September	982,817	334,579	161,655	1,479,051	585,441	2,990,830	3,576,271	5,055,322
October	1,016,077	334,111	171,123	1,521,311	630,357	3,439,206	4,069,563	5,590,874
November	1,018,435	337,228	127,349	1,483,012	557,758	2,978,546	3,536,304	5,019,316
December	989,700	343,973	150,920	1,484,593	500,697	3,397,398	3,898,095	5,382,688
Total 1941	10,892,557	3,979,588	1,626,874	16,499,019	6,218,151	30,716,617	36,934,768	53,433,787
Total 1940	8,154,492	2,852,477	908,321	11,915,290	8,887,237	14,962,813	23,850,050	35,765,340
Total 1939	9,551,548	3,001,397	820,227	13,373,172	9,140,907	11,654,928	20,795,835	34,169,007
Total 1938	6,616,787	2,237,395	633,744	9,487,926	6,830,506	7,394,291	14,224,797	23,712,723
1942								
January	1,113,319	362,840	141,438	1,617,597	585,319	3,788,786	4,374,105	5,991,702
February	922,605	319,840	134,158	1,376,603	566,575	3,477,850	4,044,425	5,421,028
March	1,006,242	296,100	131,920	1,434,262	519,357	3,643,633	4,162,990	5,597,252
April	983,607	321,667	109,593	1,414,867	567,799	3,606,741	4,174,540	5,589,407
Total 4 mos. 1942	4,025,773	1,300,447	517,109	5,843,329	2,239,050	14,517,010	16,756,060	22,599,389
Total 4 mos. 1941	3,211,727	1,383,570	430,586	5,025,883	1,827,223	7,996,834	9,824,057	14,849,940
Total 4 mos. 1940	2,923,057	1,014,479	259,184	4,196,720	2,602,607	4,203,312	6,805,919	11,002,639
Total 4 mos. 1939	3,073,128	1,069,131	261,838	4,404,097	3,470,665	3,295,755	6,766,420	11,170,517

[1] Ed. Note: Taking 80¢ per lb. as an estimated unit value for cellulose plastics, their total production in 1941 may be valued at $42,750,000.
[2] Beginning with February 1941, data do not include production or shipments of cellulose acetate safety glass sheets.

Calculation of a modulus of impact

by ARCHIE W. KOON*

IN the interest of significance, utility and convenience, mechanical tests for plastic materials have been standardized in various ways. These have to do chiefly with the shape and dimensions of the test specimen, apparatus design, method of testing and mode of reporting data. With regard to the first and last of these points, it will be noted that dimensions are established which will make for convenience in testing, whereas it is desirable for the sake of uniformity to report test values in terms of unit measurements.

For example, flexural strength is measured using a specimen with a cross section $^1/_2 \times {}^1/_2$ inch. However, it is reported in pounds per square inch. This value in unit terms—that is, the flexural strength of the material tested as a single beam loaded at the center—is calculated according to the formula:

$$S_f = \frac{3\ Pl}{2\ bd^2}$$

where S_f = flexural strength
P = breaking load
l = length between supports
b = width of test specimen
d = thickness of test specimen

Similarly, the flexural modulus of elasticity is calculated to pounds per square inch:

$$E_f = \frac{Pl^3}{4\ Dbd^3}$$

where, further, E_f = elastic modulus
D = deflection under load P

Methods of measuring impact resistance are standardized also, but there is no uniform agreement as to the basis on which to report. It has been deemed safest by some to follow the course of testing only accurately dimensioned specimens, and of reporting only the actual test. A step toward unit reporting is that recommended by A.S.T.M. 256-38, wherein the thickness of the specimen is closely specified, but the result is reported per unit width.

Notwithstanding this caution, attempts have been made to establish a modulus of impact resistance. There are current suppliers' catalogs and purchasing specifications which treat impact resistance as though it were entirely analogous to flexural strength. Upon this assumption—namely, that the energy to break a test specimen is proportional to the square of thickness—the formula prescribed is

$$M_i = \frac{I}{bd^2} \qquad \text{(Formula A)}$$

where I = energy to break test piece.
In applying this formula to notched pieces, the dimension d is taken from the bottom of the notch.

It is the thesis of the present paper that this formula and its principle are in error. First, the quality in question is energy absorption, not force. Energy is supplied, during the impact test, to fracture and tear the specimen apart. It is held to be reasonable that the energy absorption will be proportional to the area across which the rupture occurs. This being so, area is the governing factor, not shape. This hypothesis indicates the formula:

$$M_i = \frac{I}{bd} \qquad \text{(Formula B)}$$

*Columbian Rope Company.

A cursory derivation of this formula is shown below. The formula for work is:

$$W = FD$$

This can be expressed also as a modulus of energy absorption—that is, of impact resistance:

$$I = PD$$

The terms P and D are to be found in the accepted formulas for moduli of flexure and elasticity, respectively. The dependence of P and D on the thickness in the following equations may be observed by keeping the span and width constant:

$$P = \frac{2Sbd^2}{3l} = C_1d^2$$

$$D = \frac{Pl^3}{4\ E_fbd^3} = C_2\frac{P}{d^3} = C_1C_2\frac{d^2}{d^3} = C_3\frac{l}{d}$$

Therefore $I = C_1C_3\dfrac{d^2}{d} = Cd$, where C, C_1, etc., are constants.

It is generally assumed that the energy to break a specimen is directly proportional to the width and also to the modulus of impact resistance, so

$$I = M_ibd$$

and

$$M_i = \frac{I}{bd} \qquad \text{(Formula B)}$$

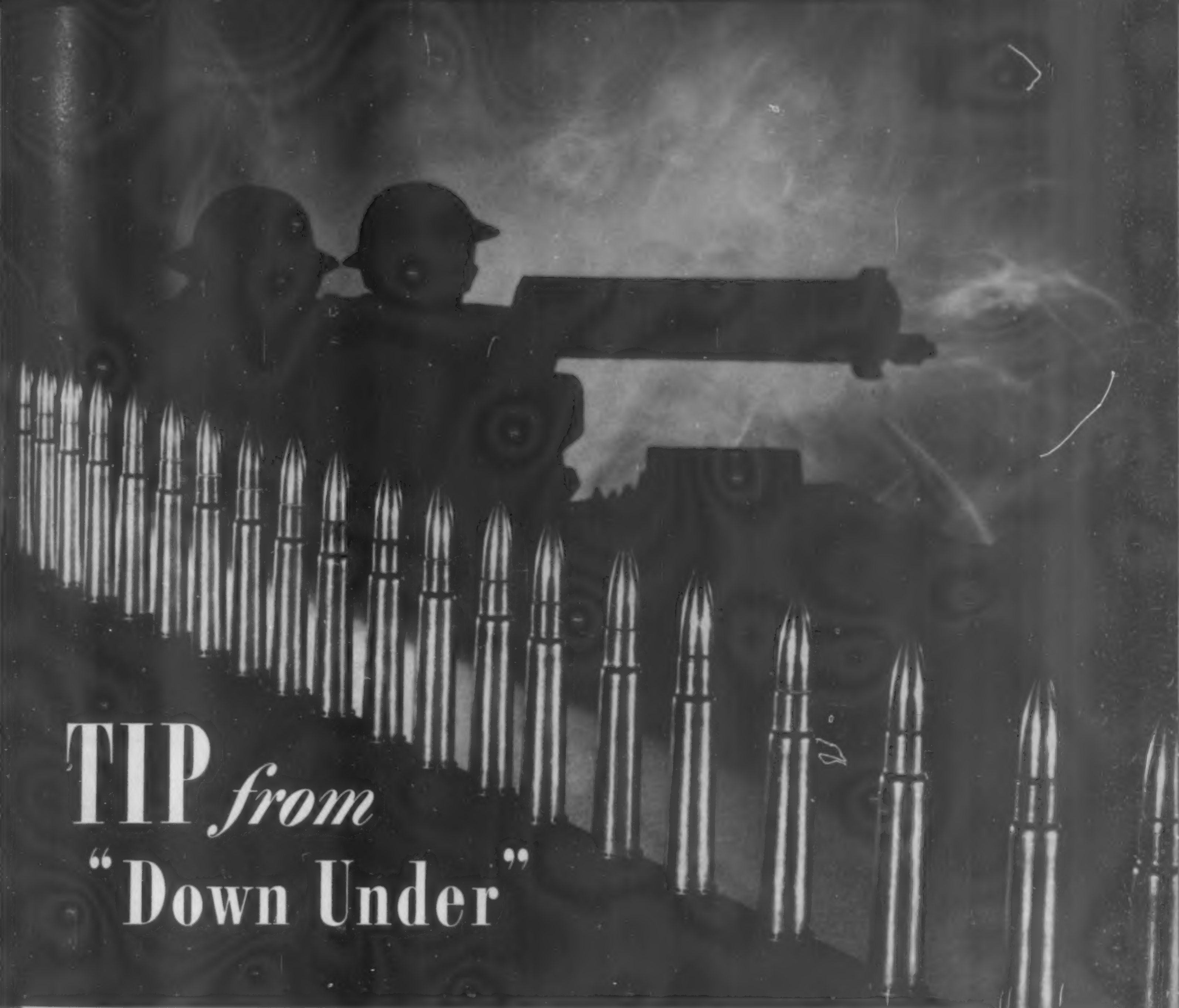
Data agreeable to this formula have been obtained using phenolic-sisal plastic of constant width but varying thickness. Series of tests were made with two grades of phenolic-sisal material. All specimens were $^1/_2$ in. wide and were tested un-notched. The results are presented in Table I.

TABLE I.—IMPACT TESTS ON TWO GRADES OF CO-RO-LITE

	Series 1			Series 2		
Thickness, In.	*Impact test*	*Impact modulus Form. A*	*Impact modulus Form. B*	*Impact test*	*Impact modulus Form. A*	*Impact modulus Form. B*
1	7.0	14.0	14.0	5.4	10.8	10.8
$^7/_8$	6.5	17.0	14.8	4.5	11.7	10.3
$^3/_4$	4.4	15.7	11.8	4.4	15.7	11.8
$^5/_8$	4.0	20.5	12.8	3.1	15.9	9.9
$^1/_2$	4.5	36.0	18.0	2.6	20.8	10.4
$^3/_8$	2.9	41.3	15.4	2.0	28.5	10.7
$^1/_4$	2.0	63.8	16.0	1.3	41.5	10.4

Moduli calculated according to formula A obviously are aberrant, whereas those calculated according to formula B are in substantial agreement. It is concluded that impact resistance is a function of area—that is, of the first power of width and of thickness.

Specifications which determine a specious modulus of impact based on the square of the thickness are misleading by two or two and one-half times with un-notched and notched material, respectively. For example, Bureau of Ships specification CFl-40 should read CFl-16. This may be held unimportant, in that the test specimens are always made to constant dimensions. Nevertheless, it is a needless error, correction of which is urged.




Cross-section of machine-gun bullet showing core-tip molded of Tenite.

MUNITIONS MAKERS in Australia find that Tenite in place of aluminum for bullet core-tips not only saves valuable quantities of metal but makes for a better balanced bullet. Tenite is uniform in texture, and can be precision molded at the fastest speeds ever attained with plastics . . . thus assuring mass production of tips of even weight and size.

Toughness and light weight are other qualities of Tenite which have put it at the front in such products as bayonet scabbards, pistol grips, ammunition rollers, and bomber visors. For data on Tenite and its availability for your product, write to Tennessee Eastman Corporation (subsidiary of the Eastman Kodak Company), Kingsport, Tennessee.

Tenite *an Eastman Plastic*

Plastics digest

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals mentioned directly to individual publishers

General

TRANSACTIONS OF THE INSTITUTE OF THE PLASTICS INDUSTRY. Vol. 10, June 1942. Several papers of interest to plastics manufacturers in this country are included in this issue of the British plastics organization. "War and the Plastics Industry," by T. L. Birrell, pages 10–15, discusses the prewar, war and postwar phases of the industry. "Plant for Injection Molding, Die-Casting, and Extrusion," by J. L. Daniels, pages 16–37, discusses principles of design for these various machines. Of particular interest is the schematic layout for a machine for extruding rods and tubes of thermosetting material. "Plastics in Aircraft," by J. D. North, pages 38–46, is concerned with problems involved in the utilization of plastics for structural members in aircraft. "The Plastics Industry," by S. M. Mohr, pages 47–52, is a review of the British industry from the points of view of organization, trade practices and materials.

AIRCRAFT PROGRAM OF THE PLASTICS INDUSTRY. W. T. Cruse. Aero Digest *41*, 226, 228, 231 (July 1942). The organization of a technical committee by the Society of the Plastics Industry to cooperate with the aircraft branches of the Government is described. This committee has five divisions, namely: thermosetting, thermoplastic, laminates, resin adhesive and publications. The program of work in which the Naval Aircraft Factory is undertaking to use plastic and plywood parts is outlined.

THE TESTING OF VARNISHES FOR USE IN CONJUNCTION WITH ANTI-SCATTER FABRICS. H. M. Llewellyn. J. Soc. Chem. Ind. (London) *61*, 60–3 (April 1942). Varnishes, lacquers, etc., and textile fabrics have both been used independently for the anti-scatter protection of window glass. Varnishes and lacquers, when used alone, usually proved unreliable, owing to the difficulty of obtaining a coating of sufficient thickness and one which would remain tough and elastic for a reasonably long period under normal conditions of exposure. Only a small minority of those tested showed anything like satisfactory performance. Textile fabrics, on the other hand, when merely stuck to the glass with aqueous adhesives are susceptible to damp conditions; they tend to peel off and to become mildewed. Laboratory and field tests, as well as experience in practice, have shown that combinations of fabrics and coatings are regarded as the most satisfactory forms of anti-scatter treatment available at the present. Each specific combination of coating material and fabric must be tested to determine the effectiveness of the combination and the resistance to moist air, aging and weathering. Coating materials or fabrics which in themselves are poor should not be used in the combination treatments.

Materials

REPLACEMENTS FOR LATEX IN FIBER PRODUCTS MANUFACTURE. R. T. Nazzaro. India Rubber World *106*, 345–6, 395 (July 1942). Latex saturated papers and flexible fiber boards have found increasing prominence in the manufacture of all grades of shoes as well as artificial leather, ladies' dress belting, imitation patent leather, book covers, cheap pocketbooks, notebooks, etc. The bulk of treated papers, however, has been utilized by the shoe trade for innersoling, midsoling, reenforcements, quarter linings, sock linings, plumping, etc. Recent restrictions on the use of rubber latex and reclaim dispersion of rubber have caused revolutionary changes in the field of paper sizing and saturation. Remarkable success has been attained in the production of saturated paper and fiber board by the use of synthetic resin emulsions. Experience indicates that vinyl polymers, acrylic ester condensation products, selected alkyds and certain types of maleics give superior results. Successful low-cost sheets are being produced commercially by the use of reclaim dispersions extended 50 percent or more with suitable resins. Resin-saturated sheets and flexible fiber boards completely free of rubber in any form are in commercial manufacture.

POLYMERIZATION OF METHYL ISOPROPENYL KETONE. B. N. Rutovskii and A. Dmitrieva. J. Applied Chem. (U.S.S.R.) *14*, 535–41 (1941). The preparation of methyl isopropenyl ketone is described. Attempts to polymerize this material without solvent and with benzoyl peroxide produced a viscous liquid; the less catalyst used, the higher the viscosity. When polymerized in acetone solutions, colored, glassy, brittle solids were produced.

Applications

THE EFFECT OF RESIN BINDER ADDITIONS ON THE PROPERTIES OF MOLDING SANDS. E. Pragoff, Jr., and C. P. Albus. American Foundrymen's Association Preprint No. 42-42, 39 pages. The effect of additions of a pulverized high melting pine resin on the physical properties of two synthetic bonded molding sands was studied. The resin increases the dry strength of the molding sand. The mold hardness is also higher and this hardness is reached sooner. The resin bonded sand retains its dry compression strength when exposed to moist atmosphere. The heat during pouring causes the resin to decompose, thereby generating an appreciable volume of gas of a reducing character. The addition of resin reduces the tendency of the synthetic bonded sand to crack on shock heating.

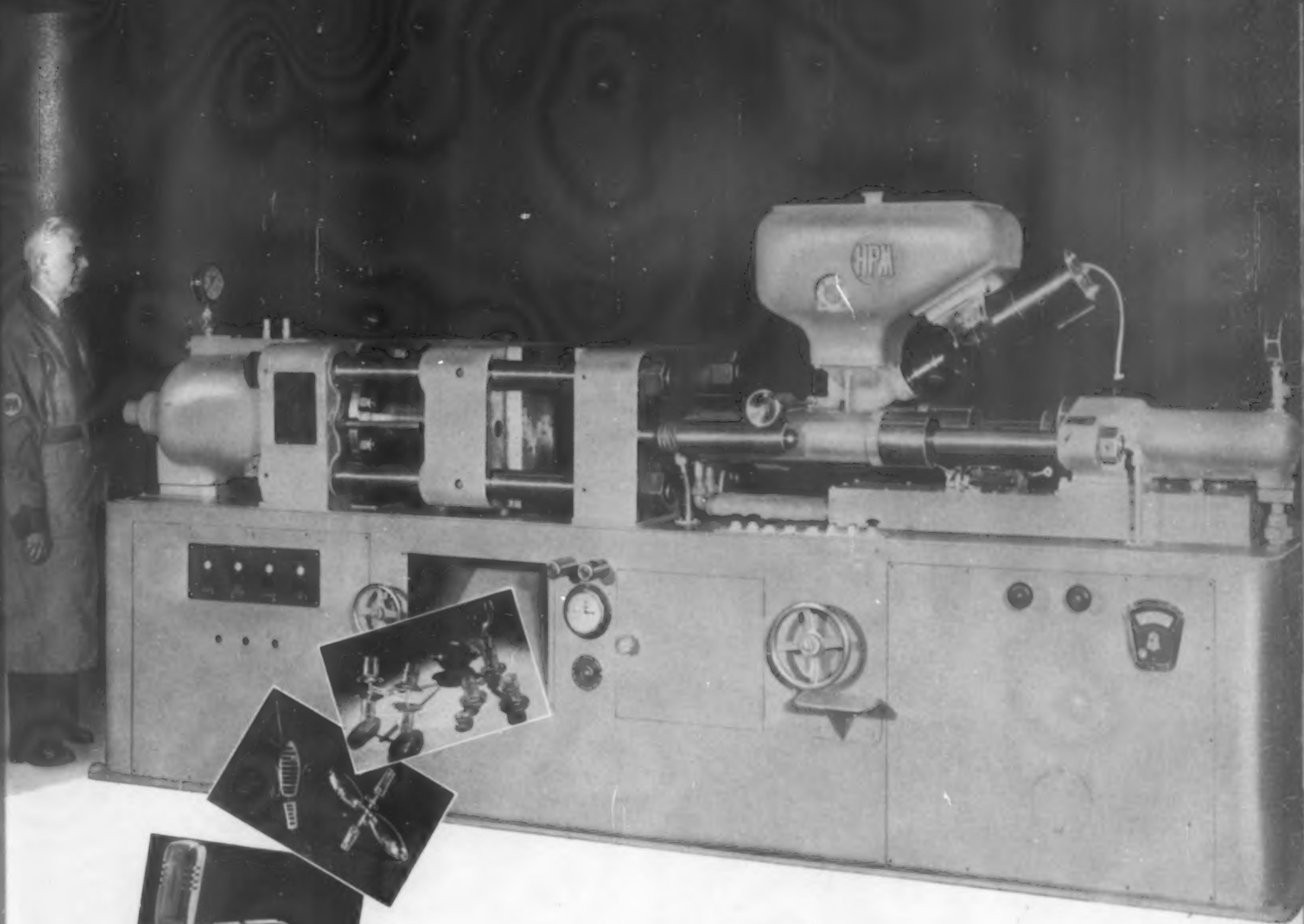
METHYL METHACRYLATE AS IMBEDDING AGENT. H. F. Halenz and L. W. Botimer. J. Chem. Ed. *19*, 313–4 (July 1942). Succinct directions are given in such a manner that anyone with some knowledge of laboratory technique could successfully imbed objects in, or make blocks of, methyl methacrylate resin. Chrysarobin, Sudan III and Indianthrene Brilliant Violet, which give light brown, red and purple colors, respectively, are recommended when colored resin mounts or blocks are wanted.

ELIMINATION OF DEHYDRATION IN HISTOLOGICAL TECHNIQUE. V. Lubkin and M. Carsten. Science *95*, 633–4 (June 19, 1942). The use of polyvinyl alcohol for mounting histological specimens is described. This resin can be used without dehydrating the specimen. The resin is cured at 56° C. Sections may be cut as thin as 4 to 5 micra without difficulty. Names of several stains which may be used are given.

Coatings

PRESENT STATUS OF AIRCRAFT FINISHES. M. A. Coler and Emmanuel de Nio. Aero Digest *41*, 254, 263–7 (July 1942). Present practice in fabric, metal and engine finishes is reviewed. Trends and developments are considered. Pertinent Government specifications are listed.

INFRARED RADIANT HEATING. F. M. Tiller and H. J. Garber. Ind. Eng. Chem. *34*, 773–81 (July 1942). The theory of infrared radiant heating is developed and expressions derived for the relation of temperature to time and for the performance ratio. Experimental data were obtained on infrared-baked urea-formaldehyde lacquers applied to cold-rolled steel to establish the validity of the equations. The various types of industrial equipment, their design and utilization are discussed.





HPM

Technical briefs

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments

Engineering

OPTICAL CONSIDERATIONS IN THE DESIGN OF TRANSPARENT PLASTIC ENCLOSURES. W. F. Bartoe. Aero Digest *41*, 233–4 (July 1942). All optical paths through transparent materials should be as close as possible to the perpendicular. Optical defects produced by thickness variations and measurement of the prismatic effects of surface irregularities are discussed.

HEAVY LOAD TESTS ON A PLYWOOD GIRDER. C. W. Muhlenbruch. Eng. News-Record, 83–5 (July 2, 1942). Tests on an 18-ft. resin-bonded plywood girder designed for the heavy loading used in highway bridge design were conducted recently at Carnegie Institute of Technology. Properly designed and constructed girders of plywood, assembled with ring connectors, may be expected to resist heavy loads with reasonable deflections and satisfactory working stresses.

FLEXIBLE MOLDS. Samuel Wein. Metal Finishing *40*, 359–62 (July 1942). Occasionally the need arises for a few plastic parts, for which the cost of a steel mold and the time involved for its preparation would be prohibitive. To fill such a need, flexible molds and phenolic resins of the casting type may be employed. These flexible molds may be made of rubber latex or synthetic rubber compounds. Steps in the process of preparing the models, molds and castings are described in detail.

Chemistry

THE DISTRIBUTION OF ACETYL GROUPS IN A TECHNICAL ACETONE-SOLUBLE CELLULOSE ACETATE. T. S. Gardner and C. B. Purves. J. Am. Chem. Soc. *64*, 1539–42 (July 1942). A technical cellulose acetate, averaging 2.44 acetyl and 0.56 hydroxyl groups per glucose residue, was esterified by *p*-toluenesulfonyl chloride. Analyses of samples removed at intervals showed that 0.198 mole of hydroxyl groups was present in the sixth or primary positions of the original cellulose acetate. This gives, by difference, a value of 0.362 mole of total secondary hydroxyl in the cellulose acetate and mathematical analyses of the rate of esterification showed that there was a first order, fairly rapid tosylation of 0.139 mole of hydroxyl, on which was superimposed a slow tosylation of 0.223 mole. The 0.139 mole was assigned to the second position and the 0.223 mole to the third by analogy with previous experience on an ethylated cellulose. The first order rate constants for the tosylation of unsubstituted hydroxyl groups in the cellulose acetate were found to be in the ratio of 2.16 for the second, 0.106 for the third and 23.4 for the sixth position.

THE PRIMARY GASEOUS PRODUCTS OF CARBONIZATION. K. Bolton, J. E. Cullingworth, B. P. Ghosh and J. W. Cobb. J. Chem. Soc. 252–63 (Apr. 1942). Substances differing widely in constitution and oxygen content were subjected to fractional carbonization up to 1000° C. A phenol-formaldehyde resin, made with ammonia catalyst, was among the group. The amounts of carbon dioxide, carbon monoxide, hydrogen and hydrocarbons, evolved at various temperatures from 400° to 1000° C., are given in tabular and graphic form.

THE STRUCTURE OF PHENOLIC RESINS. M. Koebner. Brit. Plastics *14*, 95–6, 98, 100–1 (July 1942). Novolacs and Resites differ only in the length of the chains. The larger the amount of formaldehyde used for a given quantity of phenol, the greater becomes the yield, the viscosity and the mean molecular weight. The hydroxyl groups of Novolacs remain intact and evidence is cited to show that this is the case also for Resites. Cross-linking does not take place in resins derived from *o*- and *p*-cresol.

Testing

SOME OBSERVATIONS ON THE MECHANICAL TESTING AND FLOW PROPERTIES OF INDUSTRIAL PLASTICS. E. G. Couzens and W. G. Wearmouth. J. Soc. Chem. Ind. *61*, 69–74 (May 1942). The various factors concerned in the conditioning and in the determination of the modulus of elasticity in tension, the ultimate tensile strength, the softening point and the flow properties of plastics, particularly thermoplastics, are discussed. The conclusions regarding tensile data are as follows: (1) Assuming satisfactory conditioning, modulus of elasticity is a property approximately independent of rate of loading; (2) there appear to be critical head speeds above which ultimate tensile strengths do not change much; (3) there may be an apparent yield value, which can be determined from the straight-line relationship between limit of proportionality and rate, and below which creep is negligible; (4) elongations are particularly useful in comparing specimens of an individual plastic for evidence of satisfactory production of sheet or molded form; (5) tensile strengths are of some value in comparing different plastics, but elongation must also be considered. The different methods of measuring the flow properties of plastics are discussed and some data presented. The parallel plate plastometer of Wearmouth and Small is recommended as the only one which gives data for accurate comparisons between materials.

PHENOL-FORMALDEHYDE PLASTICS UNDER CONDITIONS OF BENDING FATIGUE. D. Warburton-Brown. Plastics *6*, 210–18 (July 1942). Tensile strengths of molding compounds varied from 5500 to 30,000 lb./sq. in., depending on the filler. Bending fatigue limit of these compounds varied only from ±1.95 to ±2.40 tons/sq. in., based on the appearance of the first surface crack after 10 million stress reversals. The rate of propagation of the cracks was greatly dependent upon the type of filler, being very slow for laminated materials. A pure phenol-formaldehyde resin specimen was still unbroken at 50 million stress reversals when the value of the alternating stress was ±1.60 tons/sq. in., compared with 1.95 tons/sq. in. at 10 million reversals.

Properties

STRENGTH AND PERMISSIBLE LOAD OF SYNTHETIC MATERIAL: POLYVINYLCHLORIDE. W. Bachmann. Zeit. Vereines deutscher Ingenieure *84*, 425–31 (June 1940). The deformation mechanism of polyvinylchloride is similar to that of low molecular inorganic glasses; in both cases a local molecular exchange occurs, with continued strain and with increase of temperature. The results of fatigue tests with unidirectional stresses on bars and tubes of polyvinylchloride are given. Strength and elongation as functions of temperature and of time are shown graphically. Results of impact tests are given.

THE THERMAL AND ELECTRICAL PROPERTIES OF BITUMASTIC COMPOUNDS CONTAINING QUARTZ SAND. Willis Jackson. Phil. Mag. *33*, 81–9 (1942). The thermal conductivity of the bitumastic type of materials used as insulators is increased by incorporating quartz sand. The addition of 80 percent of sand is required to increase the thermal conductivity 6 times. The dielectric strength is decreased slightly and the power factor is increased.

Ewing Galloway

U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each

INTERPOLYMER. G. F. D'Alelio (to General Electric Co.) U. S. 2,288,315, June 30. Interpolymerizing an unsaturated alkyd resin with diallyl ether.

MOLDING RESINS. B. W. Nordlander and I. A. Hurst; B. W. Nordlander (to General Electric Co.). U. S. 2,288,321–2, June 30. Reacting an alkyd resin with a polyvalent metal oxide and adding a filler to produce a composition which can be hot-molded and ejected hot from the mold; and producing a similar product from fused copal and a polyvalent metal oxide.

TRANSPARENT HEEL. John Bolten and Robert H. Goldbaum. U. S. 2,288,388, June 30. A transparent or translucent molded heel has nail cavities and a reticulated top to prevent deflection of the nails.

TRANSPARENT FOILS. W. L. Morgan (to Sylvania Industrial Corp.). U. S. 2,288,413, June 30. Plasticizing regenerated cellulose foils with a quaternary ammonium compound or an amine or amide salt which does not cause tackiness and does not weaken, embrittle or opacify the foil.

HOLLOW ARTICLES. J. R. Hobson (to Plax Corp.). U. S. 2,288,454, June 30. Forming the neck of a hollow article by injection molding, then forming the body by extruding and shaping fresh material.

PHENOLIC RESIN. I. Kreidl and F. Nozicka (to Vereinigte Chemische Fabriken Kreidl, Heller und Co.). U. S. 2,288,533, June 30. Neutralizing a resin formed by alkaline condensation of phenol with formaldehyde, treating it with ammonia and hardening the product by adding zinc oxide.

RECOVERING METALS. K. Pattock and Meier. U. S. 2,288,547, June 30. In recovering metals from complex ammoniacal solutions the filter is charged with a sulphonated phenol-aldehyde resin.

PLASTICIZING RESINS. F. A. Bent and W. L. Ponig (to Shell Development Co.). U. S. 2,288,589, July 7. Plasticizing vinyl acetal resins with long chain alcohols derived from mesityl oxide and unsaturated ketones.

ABRASIVE DISKS. Niilo Holmsten. U. S. 2,288,624–5, July 7. Applying abrasive-coated sheets to a plywood backing and coating the abrasive sheet with a waterproof resin.

POLYMERIZING ROSIN. C. E. Tyler (to Hercules Powder Co.). U. S. 2,288,659, July 7. Polymerizing rosin in contact with acid sludge formed by treating rosin with sulphuric acid.

INSULATED WIRE. C. S. Fuller (to Bell Telephone Laboratories, Inc.). U. S. 2,288,695, July 7. Reacting a water-soluble resinifiable compound with cellulose and using the product for insulating conductors.

POLYSTYRENE. S. Caplan (to Harvel Research Corp.). U. S. 2,288,935, July 7. Polymerizing styrene in presence of a dialkyl sulphate.

SUPERPOLYMER YARNS. E. W. Spanagel (to E. I. du Pont de Nemours and Co.). U. S. 2,289,222, July 7. Adding a snagproofing composition to synthetic linear polymer yarns.

ASPHALT COMPOSITION. D. R. Wiggam (to Hercules Powder Co.). U. S. 2,289,229, July 7. Compounding tar, gilsonite, stearin pitch or other bitumens with ethylcellulose to raise the softening point and toughen the product.

CASTING RESINS. O. Hansen (to O. Hansen and P. C. Christensen). U. S. 2,289,266, July 7. Effecting separate condensations of phenol with formaldehyde and glycerol with phthalic anhydride, and evaporating a mixture of the two condensation products.

TOOTH BRUSH. H. Cave (to Fuller Brush Co.). U. S. 2,289,313, July 7. A cellulose acetate molded tooth brush base has special provision for waterproof retention of the bristle tufts.

ORIENTED POLYMERS. J. B. Miles, Jr. (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,289,377, July 14. Setting oriented synthetic linear polymers by heating in presence of an organic nonsolvent swelling agent.

CHEWING GUM. C. H. Boys (to Hercules Powder Co.). U. S. 2,289,407 July 14. Esterifying raw, hydrogenated or polymerized rosin with pentaerythritol for use in chewing gum.

TAR ACID RESINS. W. T. Brown (to Jones and Laughlin Steel Corp.). U. S. 2,289,478, July 14. Making resins from crude tar acids by direct condensation with formaldehyde.

SHAPING PLASTICS. C. V. Smith and F. P. Williams (to Univis Lens Co.). U. S. 2,289,524, July 14. Apparatus for axially aligning the opposing die surfaces in molding lenses from synthetic resins.

DIPPED LACQUER. E. M. Bright (to Plastics Patents Trust). U. S. 2,289,537, July 14. Dipping articles first into nitrocellulose in a highly volatile solvent, then into a liquid for removing the solvent.

WATER-SOLUBLE POLYMERS. H. R. Dittmar and D. E. Strain (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,289,540, July 14. Polymerizing an acrylic or methacrylic acid derivative to a water-soluble resin in presence of a persulfate percarbonate, perphosphate or the like.

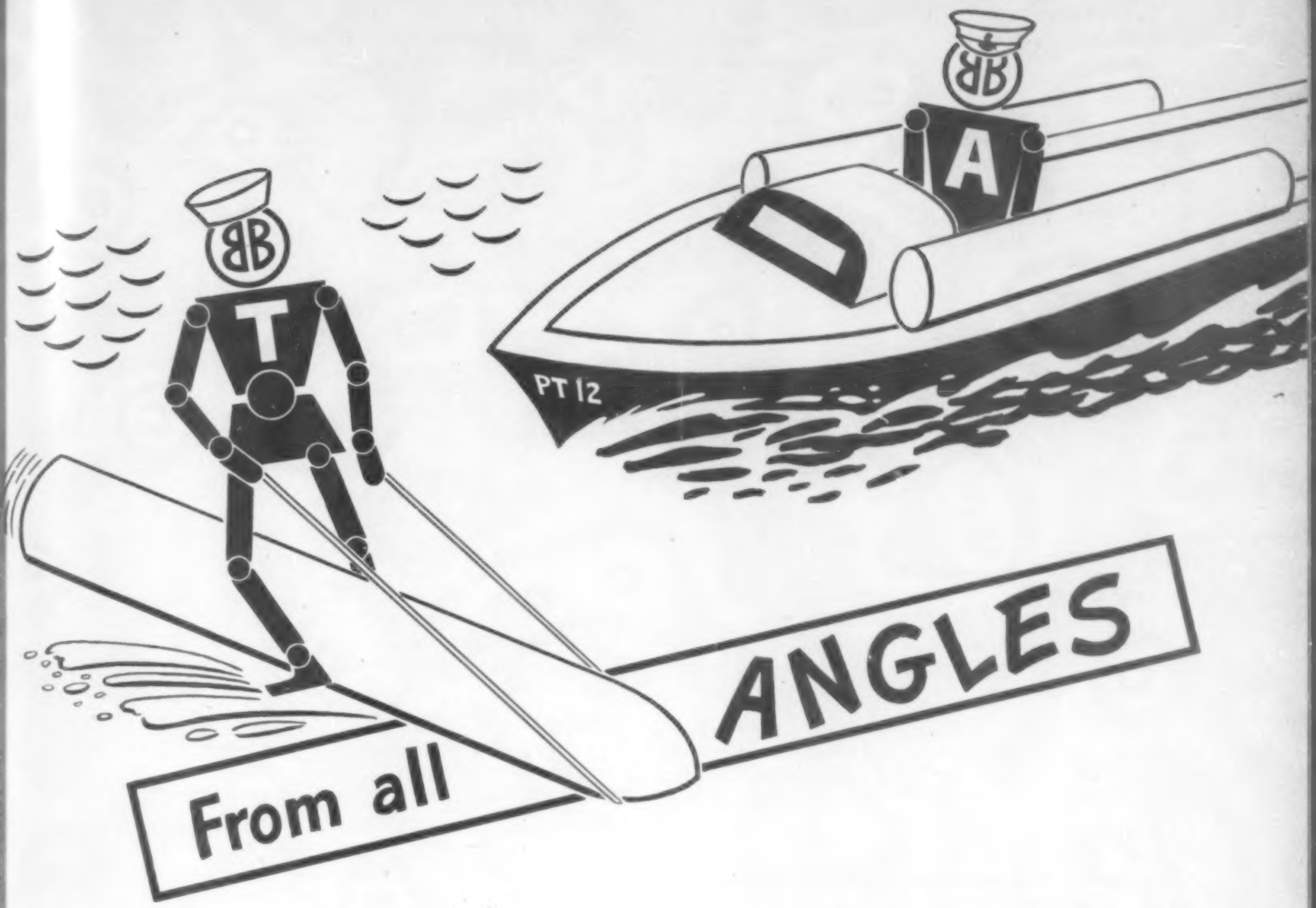
PLASTIC SHEETING. C. B. Williams (to Libbey-Owens-Ford Glass Co.). U. S. 2,289,615, July 14. Apparatus for drying plastic sheeting and laying it in horizontal folds on a support.

OIL SEAL. T. O. Kosatka (to Victor Mfg. and Gasket Co.). U. S. 2,289,659, July 14. Sealing a shaft and its housing with a standard molded resilient sealing element in a retaining shell.

MOLDING PRESS. A. B. McGinnis and W. B. Merinar (to Wheeling Stamping Co.). U. S. 2,289,671, July 14. A trackway extending across the front of a molding press above the press units for conveying mold plates.

LIGHT POLARIZERS. E. H. Land (to Polaroid Corp.). U. S. 2,289,713, 2,289,714 and 2,289,715, July 14. Applying a suspension of light-polarizing particles in a transparent plastic to a transparent support; dispersing dichroic color elements in a hydrophilic linear polymer plastic for color projection of light-polarizing images; and making a film of superimposed layers of polyvinyl alcohol for receiving stereoscopic prints.

(*Please turn to page 96*)



The light, fast P-T boats have proved the effectiveness of new ways of war by scoring successes over slow ships designed for another era of fighting. The P-T's strike suddenly, swiftly. Their torpedoes find the weak spots in the enemy's armor.

Modern molding methods are helping to win this war, too. Speed, economy of action, *striking power* against tough plastics problems are the keynotes of Tech-Art's plastics molding service. They mold all plastics by both injection and compression methods. They make all their own molds.

The wealth of experience and the modern plant facilities, now serving the Government, will be available to peacetime industry—when the peace is won.

Our Trade Mark since 1891
It stands for Quality

TECH-ART PLASTICS CO.

Successors to Boonton Rubber Mfg. Co. Molders Since 1891
41-01 36TH AVENUE, LONG ISLAND CITY, NEW YORK

ELECTRIC INSULATION. S. J. Rosch (to Anaconda Wire and Cable Co.). U. S. 2,289,732, July 14. A lattice-like structure of tough plastic insulation between a conducting wire and surrounding strands of fine wire conductors.

POWER CABLE. T. R. Scott and J. K. Webb (to International Standard Electric Corp.). U. S. 2,289,734, July 14. Insulating a conductor with lappings of a polymer tape, filling the interstices with a monomer, installing the cable and polymerizing the monomer.

CELLULOSE ACETATE FOILS. C. J. Staud and G. B. Bachman (to Eastman Kodak Co.). U. S. 2,289,739, July 14. Plasticized cellulose acetate foils are cast in presence of 0.1 to 5 percent of a polyalkylated aromatic sulfonic acid or sulfonate to facilitate stripping off the foil.

POLYSTYRENE. A. J. Warner and A. A. New (to International Standard Electric Corp.). U. S. 2,289,743 and 2,289,744, July 14. Plasticizing polystyrene with octahydrophenanthrene, octahydroanthracene or fluorene.

PARTIAL POLYMERIZATION. C. M. Fields (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,289,765, July 14. Polymerizing styrene or a methacrylate ester to a thick sirup by heat with alternate short periods of agitation and long periods of quiescence.

PROTEIN-POLYAMIDE PRODUCT. G. D. Graves (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,289,775, July 14. Compounding a synthetic linear polyamide with a protein in ratios from 9:1 to 1:4 by blending solutions of the components and removing the solvent.

SAFETY GLASS. C. J. Malm and G. J. Clarke (to Eastman Kodak Co.). U. S. 2,289,792, July 14. Facing glass plates with a melted-on film of cellulose ester and joining the coated faces to an interlayer of a compatible cellulose ester.

ANTIHALATION FILM. G. F. Nadeau and A. D. Slack (to Eastman Kodak Co.). U. S. 2,289,799, July 14. A cellulose mixed ester support for photographic film has a cellulose ester and resin subbing layer and a cellulose acetate-phthalate antihalation layer containing a dye or colloidal carbon.

SYNTHETIC FIBERS. D. F. Babcock (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,289,860, July 14. Apparatus for steam treatment of melt-spun organic synthetic fibers.

TENPINS. Harry A. C. Brinkmann. U. S. 2,289,872, July 14. Forming tenpins by joining halves molded from a high impact strength thermoplastic.

LEATHER SUBSTITUTE. P. F. Robb (to Hercules Powder Co.). U. S. 2,290,072, July 14. Artificial leather with good flexibility in the cold is made with a blend of nitrocellulose and ethylcellulose, plasticized with castor or like oils or their oxidation products.

HOLLOW ARTICLES. S. T. Moreland and V. E. Hofmann (to Owens-Illinois Glass Co.). U. S. 2,290,129, July 14. Forming hollow articles from thermoplastics by means of a parison mold having a number of cooperating neck mold units.

MELAMINE RESIN COATINGS. R. C. Swain and P. Adams (to American Cyanamid Co.). U. S. 2,290,132 and 2,290,133, July 14. Compounding alkyl-melamine-formaldehyde resins with chlorinated rubber or with ester gum to form coating compositions.

STYRENE INTERPOLYMERS. E. C. Britton, H. B. Marshall and W. J. LeFevre (to Dow Chemical Co.). U. S. 2,290,164, July 21. Interpolymerizing styrene with an alkenyl or aralkenyl cinnamate or with a phenylpropenyl ester of an unsaturated acid.

PLASTICIZED FOILS. A. Hershberger (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,290,180, July 21. Plasticizing nontacky polyvinyl butyral foils with 5.2 to 30 per cent of castor oil.

SAFETY GLASS. A. Kirkpatrick (to Monsanto Chemical Co.). U. S. 2,290,193, July 21. Bonding glass plates together with a cellulose derivative or a vinyl ester or vinyl acetal resin plasticized with a trialkyl (tripropyl to trihexyl) phosphate and a dialkyl (not higher than diamyl) phthalate or an alkyl (methyl or ethyl) ester of phthalylglycolic acid.

ATTACHING OUTSOLES. F. V. Nugent (to B. B. Chemical Co.). U. S. 2,290,204–5, July 21. Shoe uppers with an overlasted margin of vinyl resin are cemented to insoles or outsoles by being coated with chlorinated rubber and cemented with rubber or chloroprene adhesive.

BELTS. S. R. Hickok (to Hickok Mfg. Co., Inc.). U. S. 2,290,238 and 2,290,685, July 21. Straps to be worn as belts are made of a vinyl chloride:vinyl acetate interpolymer faced on one side with a fibrous woolly flocking material and slotted or perforated for ventilation.

CASEIN PLASTICS. D. Kasen. U. S. 2,290,241, July 21. Polishing white cured casein articles with a hypochlorite solution which has a staining effect, and bleaching the stained article with a peroxide.

INJECTION MOLDING. R. P. Piperoux (to Celanese Corp. of America). U. S. 2,290,249, July 21. Injecting a thermoplastic melt around a fixed insert in a mold, ejecting the article, removing sprue and grooving the article where the sprue was removed.

ION EXCHANGE RESIN. E. Melof (to National Aluminate Corp.). U. S. 2,290,345, July 21. Acid condensation of an aromatic diamine with formaldehyde or acetaldehyde to form a solid resin having pronounced anion exchange properties.

AMPULES. R. E. Moule (to General Motors Corp.). U. S. 1,290,348, July 21. Strong heat-resisting solvent proof ampules for drugs to be withdrawn into hypodermic syringes are made of polystyrene and are formed with a rigid body, a rigid cap and a thin diaphragm which is easily pierced by a hypodermic needle.

MOISTUREPROOF FOILS. G. C. Thomas (Lummus Co.). U. S. 2,290,392–3, July 21. Noncracking moistureproof coatings for cellulosic wrapping foils contain a butadiene polymer, or an isobutene polymer with molecular weight at least 50,000, dispersed in a wax.

CELLULOSE ETHER PLASTIC. A. J. Berry and E. L. Kropscott (to Dow Chemical Co.). U. S. 2,290,522, July 21. Compounding a cellulose ether with a dicarboxylic acid anhydride for molding or extrusion purposes.

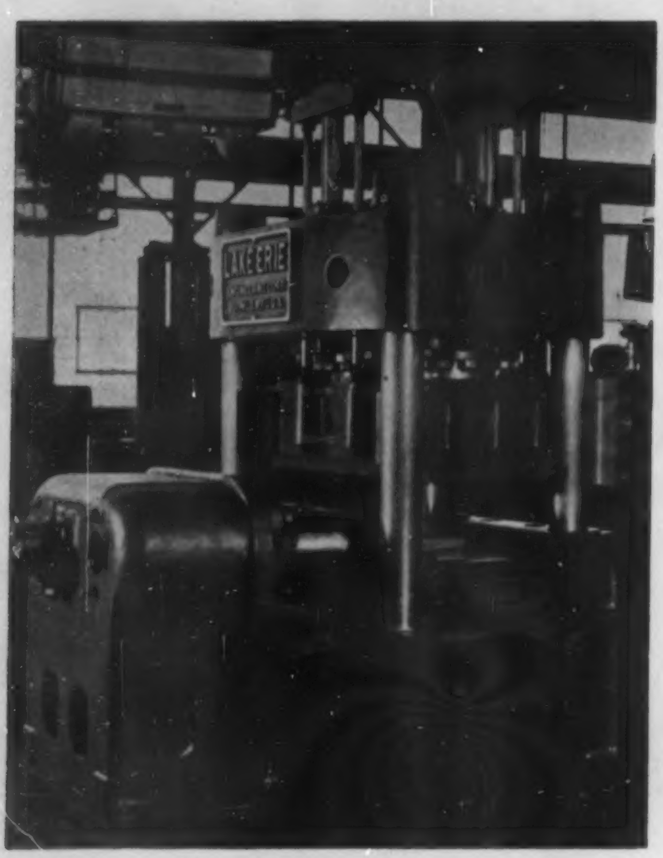
STYRENE INTERPOLYMER. R. R. Dreisbach, S. M. Stoesser and A. W. Hanson (to Dow Chemical Co.). U. S. 2,290,547, July 21. Interpolymerizing styrene with less than 10 percent of phenylacetylene.

BAKING ENAMEL. A. E. Gessler and C. J. Rolle (to Interchemical Corp.). U. S. 2,290,550, July 21. A light-colored enamel containing a urea resin plasticized with a modified alkyd resin is based by flash heating at 1000° F. or higher.

MELT COATINGS. T. A. Kauppi (to Dow Chemical Co.). U. S. 2,290,563, July 21. A coating applied as a melt contains a low viscosity ethyl cellulose, paraffin wax and a naphtha-soluble resin blending agent.

VINYL-ACRYLATE RESINS. H. T. Neher and L. N. Bauer (to Rohm and Haas Co.). U. S. 2,290,600, July 21. Interpolymerizing an alkyl (methyl to butyl) methacrylate with 2 to 20 percent of vinyl alcohol.

Machinery and Equipment



★ A 450-TON ANGLE TYPE HYDRAULIC PRESS FOR molding phenolic plastics has recently been developed by Lake Erie Engineering Corp. The press (above) is complete and ready for connection to accumulator pressure system. The main bed is claimed to be of rugged design, cast in one piece to maintain correct vertical and horizontal alignment. The dimensions of the platen are 24 in. by 50 in., and the press has a 12-in. vertical stroke and a 10-in. horizontal stroke.

★ A NEW ENGINE LATHE TOOL HOLDER THAT IS said to cut tool changing time to approximately five seconds and to reduce operating time greatly has been developed by the Lane-Wells Co. The device consists of a tool post which can be fitted on to any engine lathe carriage compound rest. The detachable heads fit into a cylindrical member clamped into the tool post. Standard high speed tool bits used for boring, turning, threading, facing or forming are fastened into the heads and each bit remains in place in the head. Drills and reamers can also be used. Four sizes of the device fit all standard makes of engine lathes from 10 in. to 24 inches.

★ AIRLOC COWLING FASTENERS FOR PLYWOOD construction are available from the United-Carr Fastener Corp. A pronged steel washer mounting is described as making installation of the fasteners easier and increasing the bearing strength of the plywood to which they are attached. The prongs are located at the outside edge of the washer and are said to draw it evenly into the wood.

★ THE ELIMINATION OF MERCURY FROM THE Taylor flow and liquid level manometer developed by the Taylor Instrument Co. is described as having removed the possibility of product contamination and the hazard of mercury being blown due to line surges or carelessness. A new torque tube assembly designed to eliminate friction and lubrication replaces the stuffing box, and gives a completely closed system. This new assembly is also reported to save time in maintenance. The instrument is equipped with metal bellows built to withstand high over-range. According to the manufacturer, the aneroid manometer is accurate under steady flow conditions within 1 percent of scale range. It is available for all types of indicating and recording meters and controllers, and is supplied for standard ranges between 20 and 500 in. of water. The range can be changed right on the job by substituting precalibrated torque tubes.

★ A LINE OF EXPLOSION PROOF TIMERS SUITABLE for operations in atmospheres containing gasoline, naphtha, petroleum, benzol, acetone, lacquer solvent, natural gas, etc., are now available from the R. W. Cramer Co. Both remote and on-hand timers are available.

★ NEW MODEL No. 17 COOLANT PUMP (ABOVE) DESIGNED for use on lathes, shapers, milling, drilling and grinding machines, where a steady stream of coolant or cutting oil is necessary, is now available from the Eastern Engineering Co. The pump is constructed of cast iron, and designed so that there is no metal to metal contact below the liquid level. The pump inlet is tapped for $1^1/_4$-in. standard pipe, and the outlet for $^1/_2$-in. standard pipe. The pump is sealed to the motor base. The pump is said to have a maximum pressure of 6 lb. per sq. in., and a maximum capacity of 17 gal. per minute.

The 300-TON "STANDARD"

for today's requirements

A big, husky press with the flexibility, speed, accuracy and other advantages of lighter "Standard" units.

•

Automatic Time-cycle Control assures uniform, high-quality moldings. Saves time, labor, material.

•

"Slow Close" Device. New. Positive control of final closing speed. Ideal molding action for precision parts, insert work, moldings with thick and thin sections.

This press is ideal equipment for today's requirements . . . automatic except loading and unloading, self-contained, toggle support at all four corners of platen, no mold "cocking," skilled molders not required to produce work that meets rigid Army and Navy specifications with minimum rejects.

For war production now . . . for economical production later . . . install "Standard" Presses. New catalog now on press . . . write for copy.

F. J. STOKES MACHINE COMPANY
5934 Tabor Road Olney P. O. Philadelphia, Pa.

Representatives in New York, Chicago, Cincinnati, St. Louis, Cleveland, Detroit

Pacific Coast Representative: L. H. Butcher Company, Inc.

F.J.Stokes MOLDING EQUIPMENT

FJS Est. 1895

Publications

Write direct to the publishers for these booklets. Unless otherwise specified they will be mailed without charge to executives who request them on business stationery. Other books will be sent postpaid at the publishers' advertised prices

---

Plastics

by J. H. DuBois
Industrial Plastics Division, American Technical Society, Publishers, 850 E. 58th St., Chicago, 1942
Price $3.00 **295 pages**

This book was written to give engineers, designers and students a simplified presentation of the manufacture and use of the important plastic materials and products with tables of their properties and basic design information. It does this admirably. The book is comparatively free from typographical errors or misstatements of fact. However, it does tend to overemphasize some materials and developments associated with the author's business connection. For example, cold-molded plastics get approximately 11 pages to about 7 pages for cellulose acetate plastics. Mycalex gets as much or more attention than ethyl cellulose, nylon, lignin or alkyd resins.

The author first gives the reader an introduction to the terminology of plastics and the scope of the industry. The next 8 chapters are devoted to describing the properties and uses of the various commercial materials. Three chapters are concerned with the processes employed in molding and finishing plastics. The last 2 chapters relate to selecting materials and the design of molded products. A 14-page index facilitates the location of specific subjects in the text.

The book is well illustrated and the physical make-up is excellent. The author's style of writing and the choice of type by the publisher combine to make the book easy reading. It should be of interest and assistance to users of plastics who want in abbreviated form general information concerning these materials without a detailed consideration of the chemical and engineering problems of the industry. G. M. K.

This Chemical Age

by Williams Haynes
Alfred A. Knopf, 501 Madison Ave., New York, 1942
Price $3.50 **385 pages**

A sound background of chemistry and the chemical industry, clear definitions of basic chemical principles and processes, an abundance of homely anecdote and a colorful narrative style combine to make this a book that the lay reader will enjoy, be he ever so ignorant of the structure of the molecule. "The Miracle of Man-made Materials," Mr. Haynes' subtitle, indicates the manner in which he treats his subject matter.

Specifically, the book answers such questions as these: "What are the synthetic materials we use every day made of? Who were the men who put them together? Just how did they do it?" Nylon, rayon, cellophane, synthetic rubber, coal-tar dyes, the sulfanilimides, synthetic perfumes, colorfast paints, celluloid are a few of the materials discussed. Under the chapter heading, "Materials for Tomorrow," the principal plastics are reviewed.

Sixteen illustrations in full color do justice to the beauty of the synthetic materials and suggest the quality of their texture. There is a brief bibliography, and a simple glossary of words that "the layman guesses he understands," but is nevertheless pleased to find succinctly construed. D. M.

The Technology of Natural Resins

by C. L. Mantell, C. W. Kopf, J. L. Curtis and E. M. Rogers
Published by John Wiley and Sons, Inc., 440 Fourth Ave., New York, 1942
Price $7.00 **506 pages, 81 illustrations, 147 tables**

"The collection, grading, sorting, distribution, preparation for marketing, warehousing, and the commerce of the natural resins is a coordinated and systematic business, worldwide in its ramifications, connections and operations. The business is as old as the varnish art and practice itself. In its early stages it was conducted with much secrecy, confusion of names, and generally with an aura of mystery. Designations which hid the identity of the resin, or else a multiplicity of names for the same article, coupled with sorting of resins to satisfy individual idiosyncrasies of purchasers added to the confusion."

Recognizing the desirability and necessity of obtaining fundamental information on the products they were distributing, the American Gum Importers Association and the Netherlands Indies trade group established laboratories in the United States in 1932–33 to conduct research work on the natural resins. This book reviews the progress in international standards for name designation, grade indications and physical and chemical specifications, as well as advances in the technology of processing and applying these products which have resulted during the ten years of this organized effort.

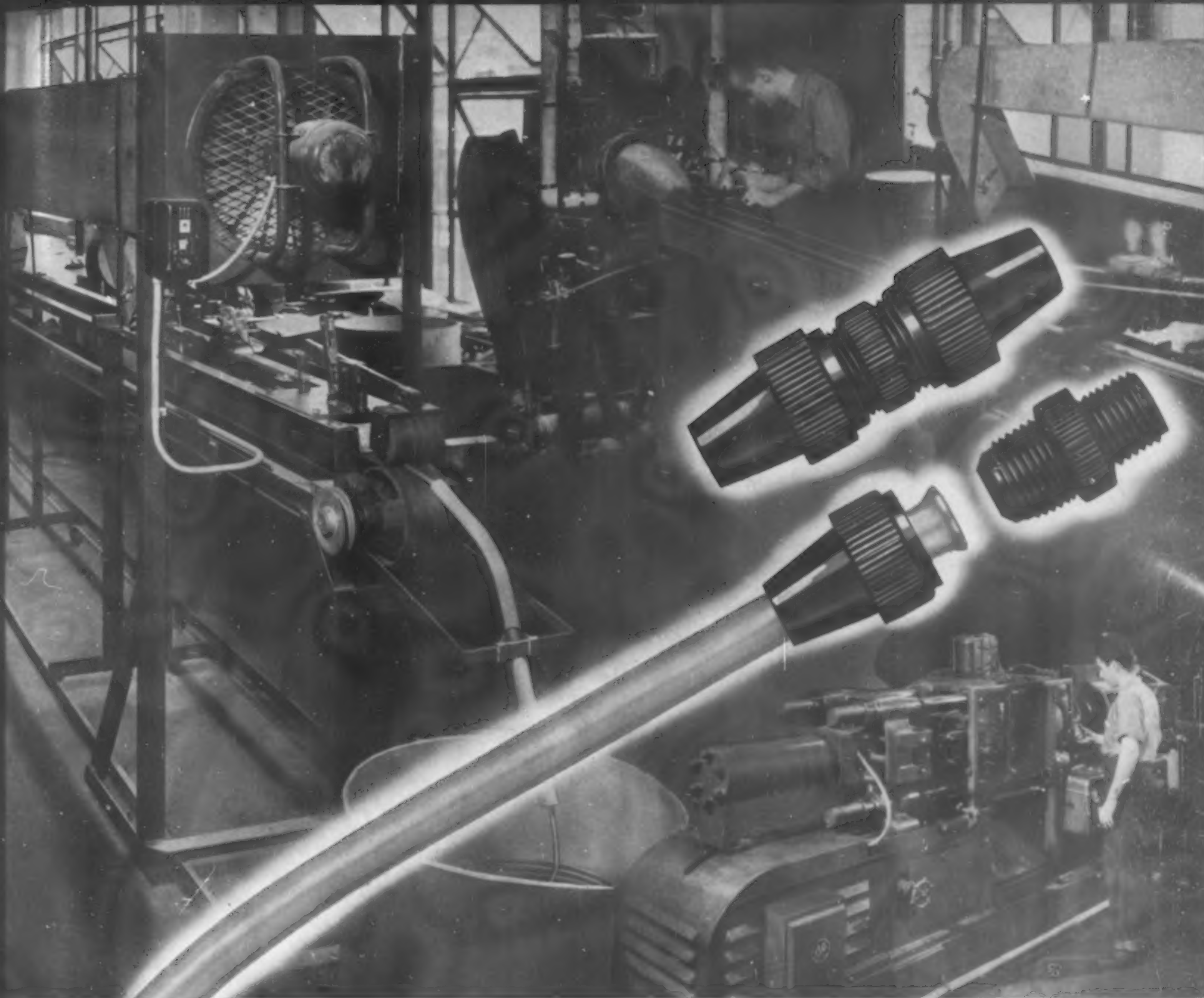
A gap in the technical literature concerning the properties, processing, identification and testing of damar, copal, East India and related natural resins has been creditably taken care of by this volume. The exclusion of rosin and shellac and, of course, synthetic resins from consideration in the text creates an artificial situation which results in a one-sided presentation of the position of natural resins in the various chapters pertaining to industrial applications and formulas. However, anyone concerned with products or processes in which resins are used will want a copy of this book at hand for reference purposes.

G.M.K.

★ "PLASTICS FROM AGRICULTURAL MATERIALS" is the title of Bulletin 154 of the Iowa Engineering Experiment Station, in which Drs. Sweeney and Arnold record their conclusions in regard to the production of plastic materials from agricultural products. Plastics of high impact strength and low water absorption can be produced from low-cost agricultural products and by-products, is one conclusion drawn as a result of the investigation which covered four plastic materials. Single copies of this 52-page bulletin may be obtained without charge from the Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa.

★ GOOD NEWS FOR QUARTERMASTER CORPS CONtractors is contained in the War Department announcement that the forms upon which bids are to be submitted from now on will be greatly simplified by using the new Bidder's Reference Book recently completed by the legal staff under Brigadier General C. L. Corbin, Director of Procurement Service, Office of the Quartermaster General. This pamphlet, first of its kind issued by one of the Armed Services, is a compilation of all standard instructions to bidders, which govern the manner of submitting bids on any kind of purchase. It contains, in their latest revised form, all contract provisions used in preparing a contract for the purchase of any Quartermaster item. The books will be issued by Quartermaster Procuring Depots to all bidders on the bidders' list for their future reference.

★ A NEW 24-PAGE MANUAL, DEDICATED "TO USERS of equipment who want the continued benefits of their air conditioning, refrigerating and heating systems," has just been issued by the Carrier Corp., Syracuse, N. Y., and is available from them. The booklet is entitled "Civilian Conservation of the B.T.U."

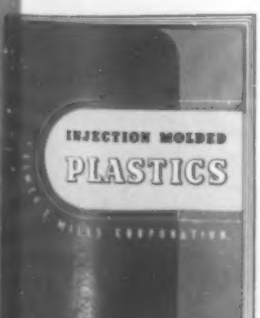


Background for Plastic Development

War has brought many changes in the field of thermoplastics, not only in the type of products being molded, but also in their applications which help to ease the perplexing problems of production. Outstanding among the latest plastic developments are MILLS-PLASTIC Tubing and Fittings, designed to replace strategic metals. The unusual characteristics and qualities of these products give them almost unlimited scope for commercial and industrial uses. MILLS-PLASTIC, in many instances, will remain a permanent and vastly superior application.

The latest type machinery and equipment for both injection and extrusion molding are available to produce war work needs with speed and economy. Our engineers and craftsmen are specialists in solving production problems. Please feel free to consult us.

Your signature on your letterhead brings you a copy of this catalog containing data and illustrations of molded thermoplastics . . . and MILLS-PLASTIC



MILLS-PLASTIC

*Trademark of The Dow Chemical Co

ELMER E. MILLS CORPORATION

olders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Crystallite Polystyrene, Styron, Lustron, Loalin, Vinylite, Mills-Plastic, Saran and other Thermoplastic materials.

812 WEST VAN BUREN STREET • CHICAGO, ILLINOIS

In the plastics picture

★ SEVEN BROAD PRINCIPLES GOVERNING ALL WARtime construction have been established by the War Production Board and the War and Navy Departments. Privately and publicly financed construction, as well as direct war plants, must meet the seven criteria which are as follows:

1. Essential for the war effort.
2. Postponement of construction would be detrimental to the war effort.
3. It is not practical to convert or rent existing facilities for the purpose.
4. Construction will not result in duplication or unnecessary expansion of existing plants or facilities now under construction or about to be constructed.
5. All possible economies have been made in the project, resulting in deletion of all nonessential items and parts.
6. The projects have been designed of the simplest type, just sufficient to meet minimum requirements.
7. Sufficient labor, public utilities, transportation, raw materials, equipment and the like are available to build and operate the plant. The manufactured product can be stored until needed.

★ BAKELITE CORP., UNIT OF UNION CARBIDE AND Carbon Corp., announces the following additions to the personnel of their Research and Development Laboratories in Bloomfield, N. J.: Thomas B. Gibb, Jr., Philip F. Wangner, Jr., Robert E. Muller, Joseph H. Leuner, Walter A. Milles and Richard E. Nicalson.

★ REICHHOLD CHEMICALS, INC., OF DETROIT, manufacturers of synthetic resins used in making paint, varnish and lacquer, are reported, to be constructing with Defense Plant Funds a new plant to provide chemicals for making smokeless powder. The new plant will be larger than the company's main establishment, which has itself been enlarged to permit manufacture of phthalic anhydride, Reichhold's largest war item. The company also makes dibutyl phthalate, another smokeless powder ingredient, together with camouflage paints and special paints for preventing barnacle formation on submarines.

★ AMERICA'S MODERN PLASTICS EXPOSITION under the direction of W. L. Stensgaard & Assoc., Inc., Chicago, Ill., continues to bring plastics to the people. Two highly successful showings have just been completed, one at Loveman, Joseph & Loeb, in Birmingham, Ala., and the other at Rich's Department Store in Atlanta, Ga., where the Modern Plastics Exposition was a star feature of that store's 75th anniversary.

★ TO AID IN THE EVALUATION OF LUMINESCENT materials, an exhibit has been prepared and is now being shown at the headquarters of the National Paint, Varnish and Lacquer Assn., 1500 Rhode Island Ave., N. W., Washington, D. C. The exhibit is the joint work of Subcommittee No. 43 of the New York Paint and Varnish Production Club and Dr. Henry A. Gardner of the National Paint, Varnish and Lacquer Association. An effort has been made to present as many possible ideas of the uses of luminescent materials as are known today. The exhibit includes an air raid shelter where walls and ceilings have been coated with phosphorescent paint; a demonstration of how traffic may be conducted in the dark; and a variety of articles coated with luminous pigments. The exhibit is opened daily except Saturday, from 2:30 to 4:30.

★ LEADING CHEMICAL COMPANIES OF AMERICA will be among the exhibitors at the National Chemical Exposition scheduled for November 17–22 at the Sherman Hotel in Chicago, it was announced recently by the Chicago section of the American Chemical Society. The National Industrial Chemical Conference will be held in conjunction with the Exposition. Victor Conquest, Director of Research for Armour & Co., is chairman of the show committee, and serving with Mr. Conquest on the committee are: A. Guillaudeu of Swift & Co., W. M. Hinman of the Frederick Post Co., W. C. Johnson of the University of Chicago, L. E. May of the Sherwin-Williams Co., R. C. Newton and H. E. Robinson of Swift & Co.

★ THE FOURTEENTH ANNUAL BOSTON CONFERence on Distribution is scheduled for October 5 and 6 at the Hotel Statler in Boston, according to an announcement by Daniel Bloomfield, director. Details of program and list of speakers will be announced at a later date.

★ A MINOR REVISION IN THE FORMULATION OF Durez 11540, a general purpose phenolic molding compound manufactured by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y., is reported by the company to have resulted in making it adaptable to many new uses. This material is described as having slightly higher impact strength and greater water resistance than former top-grade general purpose material, and is said to give an excellent surface finish.

★ EVANS-WINTER-HEBB, INC., DETROIT, MICH., announces the formation of Instaset Plastics Division for injection molding of thermoplastics and thermosetting parts used in producing war materials.

★ THE TIGHT CLOSURE CO., MILWAUKEE, WIS., IS now equipped to do custom molding of thermosetting plastic products. Their equipment includes compression molding presses ranging from 65 to 300 tons in size, operating at temperatures up to 350° F.

★ A. BROTHMAN AND A. P. WEBER, FORMERLY OF the engineering dept. of the Hendrick Manufacturing Co., are now affiliated with the Chemurgy Design Corp., consulting engineers, New York City. Mr. Brothman as chief engineer and vice-president, and Mr. Weber as secretary and assistant to the president, will jointly supervise the engineering-contracting division as well as the process equipment consulting design activities in their new organization.

★ RALPH HEMPHILL, EXECUTIVE IN THE PLAStics, aviation and Diesel engineering fields, announced at the recent dedication ceromonies of the Hemphill Institute of Technology the formation of the Ralph Hemphill Research Foundation. Mr. Hemphill explained that the primary objective of the Foundation was to foster the development of products and methods that are of military value in pursuit of America's victory program. Members of the Technical Board of the Foundation are Thomas M. Shelton, chief of training at the Aero Industries Technical Institute, John F. Delmonte, research director of the Plastics Institute, Ray E. White, chief engineer of the Hemphill Institute of Technology, and Lieut. W. H. Coffin, operating manager and flight engineer of the United Flying Schools of America.

★ GENERAL ANILINE AND FILM CORP. ANnounces the appointment of Dr. Evan Clifford Williams, research chemist and chemical engineer, as chemical director and vice-president of the corporation, and his election to the Board of Directors.

★ THE NEW $18,000,000 STYRENE PLANT WHICH was to have been constructed at Port Neches is to be built instead at Velasco, Texas, according to a dispatch to the *Galveston News* from Dr. W. H. Dow and S. H. Husband of Dow Chemical Co.

★ SEVERAL NEW TYPES OF SEALING COMPOUNDS adapted both for metal and for plywood construction have recently been developed by the Presstite Engineering Co., St. Louis, Mo. One type has been especially designed to seal joints and seams in aluminum construction, as well as to provide good adhesion for synthetic glass with, the manufacturer claims, no effect on the synthetic glass at any working temperature. It is said to remain flexible at extremely low temperatures. This compound is reported as particularly suitable for sealing synthetic glass turrets and gunners' bays in military aircraft. Joints sealed with this compound are said to be tight against air, salt water, 100 octane gasoline, aircraft fuel and motor oil. The sealer is compounded without volatile solvent and is furnished in the form of an extruded ribbon with a cloth backing to facilitate application. The manufacturer claims that it is non-corrosive, non-drying, non-hydroscopic, non-polymerizing and permanently elastic.

A second type of sealing compound produced by this company is described as a brush-on aircraft cabin sealer, designed to be used wherever a water and air-tight seal is required, and particularly suitable for sealing cabins of stratosphere planes. It can be applied with a paint brush or spray gun, and tests are reported to have proved that the compound withstands temperatures as low as minus 90° F. and as high as 212° F., still maintaining good adhesion both to polished and to zinc chromate primed aluminum. The dried film of this sealing compound is said to have no effect on rubber or the vinyl resins, and flexibility tests at all temperatures above limits are reported to show no embrittlement of the compound and no loss of adhesion.

Two other sealing compounds have also been developed which are described as especially suitable for sealing plywood tanks against aviation and aromatic fuel. One is a brush, spray or slush-type plywood fuel tank sealer said to be resistant to aromatic fuels. It is applied in two coats, and the maker claims the product maintains good adhesion to plywood under working temperatures down to minus 70° F. A second is a brush-on type sealer, resistant to aromatic fuels, used for sealing flange fittings into plywood fuel tanks.

★ AT THE CARNEGIE INSTITUTE OF TECHNOLOGY, Pittsburgh, Penna., the course in Industrial Design, under the direction of Peter Muller-Munk, offers concentrated instruction in the use of plastic materials as design media.

★ THE SOCIETY OF PLASTICS ENGINEERS (FORmerly the Society of Plastics Sales Engineers) will hold a joint meeting with the Engineering Society of Detroit on Sept. 18 in the Horace H. Rackham Educational Memorial Building, Detroit. The speakers will be Lieutenant Commander I. O. Phillips, of the Navy Bureau of Ordnance; Col. M. B. Chittick, of the Chemical Warfare Service; and Dr. T. S. Carswell, of the Monsanto Chemical Co.

★ C. L. GABRIEL, FOR 22 YEARS WITH THE COMMERcial Solvents Co., has joined the Publicker Commercial Alcohol Co., Philadelphia, Penna., where he will concentrate on new developments in the field.

★ TWO NEWLY DEVELOPED OIL-SOLUBLE RESINS, Durez 409 and Durez 420, have just been announced by Durez Plastics and Chemicals, Inc., North Tonawanda, N. Y. These two new resins were formulated of less critical raw materials to enable paint, varnish, printing ink and wax manufacturers to continue existing production of staple items. Durez 409 is adaptable to air-dry and baking finishes; Durez 420 is designed for hard mixing varnishes and spars, may be used as film for water-thinned paints and in certain types of adhesives.

★ IRVING J. WALKER HAS RESIGNED AS VICE-president of the Technicraft Co., Inc., 121 E. 24th St., N. Y. C. Monroe W. Rothschild was elected president, and Benjamin J. Kallen, vice-president.

★ B. F. GOODRICH CO., AKRON, OHIO, ANNOUNCES that its research laboratories have developed a superior type of hard rubber made of Ameripol, the company's synthetic rubber. The synthetic hard rubber, the Goodrich company says, will stand, before softening, temperatures 100 deg. F. higher than will the best hard rubber made from natural crude. The company has also produced from Ameripol a synthetic rubber thread which it believes to be the first developed in this country. The new thread will be used at the present time solely for harnesses for parachutes, gas masks, respirators and related military purposes.

★ LARGE-SCALE PRODUCTION OF AMMONIUM THIOcyanate is now under way at the Everett, Mass., plant of the Eastern Gas and Fuel Associates, it was announced by Fred Denig, vice-president of Koppers Co., in charge of Research. The plant has a large capacity, and is built to produce both crystals and 30 percent liquor. Ammonium thiocyanate is employed by the chemical industry as a reagent and as a starting point for a number of other chemical compounds. It is also used in resin manufacture; in the textile industry for dyeing, finishing and printing of cloth; in the metallurgical industry for finishing and pickling of metals; in photography; in pharmacy; as a chemical for insecticide manufacture and as a weed killer.

★ SEVERAL TYPES OF PLASTIC COATING, BOTH clear, transparent and dark viscous, are available from the Marley Chemical Co., Detroit, Mich. Marlox Air Dry and Marlox 75-25 are both clear, transparent protective coatings which may be brushed, dipped, sprayed or roll-coated, and which are said to adhere to any surface including wood, metal, textile, paper, glass and fiber. The manufacturer claims that treated products will withstand immersion in boiling water, and will be unaffected by the action of weak acids, alkalies or alcohols. The chief difference between these two types of coating is the drying time. Marlox Air Dry dries in 6 to 8 hours, Marlox 75-25 in 15 to 25 minutes.

Martex is a black viscous coating which is described as having unusual sound-deadening and insulating value. It is said to be capable of adhering to any surface, and will not slide or creep in temperatures up to its boiling point. It will only char at 600° to 700° F, the manufacturer claims. This coating can be brushed, troweled or sprayed with the proper equipment.

★ CALCO CHEMICAL DIV., AMERICAN CYANAMID Co., announces the appointment of R. D. Howerton as manager of its Chicago office, with headquarters at 146 W. Kinzie St.

★ SUPERIOR PLASTIC CO. HAS MOVED TO A NEW address at 426 N. Oakley Blvd., Chicago, Ill. All departments will henceforth be located at this new address.

★ SEABOARD ENGINEERING CO. ANNOUNCES THE opening of an office at 29 Church St., Paterson, N. J., to do general industrial engineering, tool and machine design.

★ ADDITIONAL AMERICAN PROPERTIES OF FRITZ von Opel, scion of the German automobile manufacturing family, were taken over recently by Leo T. Crowley, Alien Property Custodian. The additional seizures involved Westminster Industrial Corp., Amerlagene, Inc., and six United States patent applications pending in his name. These applications cover processes for molding plastics, and if it is found after examination that these processes can be useful to American industry, issuance of patents will be expedited and the processes made available to responsible American producers.

★ THE DETROIT RUBBER AND PLASTICS GROUP will meet at the Hotel Detroit Leland in that city on Oct. 2, when the principal speaker will be C. J. Cleary, of the Matériel Center, Army Air Force, Wright Field.

Washington Round-Up

Current news, Government orders and regulations affecting the plastics industry, with analyses of the plastics situation

REORGANIZED PLASTICS SECTION

The Synthetic Rubber Section and the Organic Plastics and Resins Section have just been combined by the War Production Board into an as yet unnamed amalgamated group. Frank Carman, former Chief of the Synthetic Rubber Section, will head the new unit. Mr. Carman is a rubber chemist who has been employed by the B. F. Goodrich Co. and the Armstrong Cork Co. He was associated with E. W. Stettinius, Jr., in the early days of OPM. Arthur E. Petersen, former Chief of the Organic Plastics and Resins Section, has been assigned to confidential work as a consultant to Dr. Reid, the head of the Chemicals Branch.

The personnel of the Plastics Section with the exception of Mr. Petersen will probably be taken over *in toto*. Some members of the Synthetic Rubber Section will go to the Rubber Branch, WPB, while others will join the new unit.

THERMOPLASTICS ORDER AMENDED

The effective date of the scheduling provision of the thermoplastics order (M-154) has been changed to October 1. The WPB announced that this was "pending revision of thermoplastics control which will take into account the altered conditions in demand."

At the same time, WPB issued two supplementary orders, M-154-a and M-154-b, which, respectively, restricted the use of polyvinyl butyral to war orders except by special authorization, and provided that methyl methacrylate sheet scrap cannot be disposed of except to re-process into sheeting.

Text of the amendment to M-154 and of the supplementary orders follows:

[Amendment 2 to General Preference Order M-154]

GENERAL PREFERENCE ORDER M-154 is hereby amended as follows:

1. Paragraph (b) is hereby amended to read as follows:

(b) *Placing of orders.* On and after September 1, 1942, no producer shall accept and no person shall tender an order for delivery of thermoplastics unless such order is accompanied by a certificate manually signed by the person (or his duly authorized agent) tendering such order containing representations by the person seeking delivery that the thermoplastics sought will not be used in violation of paragraph (f) of this order.

2. Paragraph (d) is hereby amended by striking the words and figures "15th of August, 1942" in the opening paragraph and substituting in their place the words and figures "1st of October, 1942."

[Supplementary Order M-154-a]

Supplementary Order M-154-a—(a) *Definition.* For the purpose of this order "polyvinyl butyral" means polyvinyl butyral resin formed by the reaction of butyraldehyde with a hydrolyzed polymer of vinyl acetate.

(b) *Restriction on disposition of butyral.* No person shall use, process or deliver polyvinyl butyral except as follows:

(1) Pursuant to the terms of a contract, subcontract or order for polyvinyl butyral or products made therefrom, where such polyvinyl butyral or such products are to be delivered to, or incorporated into any material to be delivered to, the United States Army, Navy, Coast Guard, Maritime Commission, or War Shipping Administration, or the Government of any country, including those in the Western Hemisphere, pursuant to the Act of March 11, 1941, entitled "An Act to Promote the Defense of the United States" (Lend-Lease Act), or the Government of any of the following countries: Belgium, China, Czechoslovakia, Free France, Greece, Iceland, Netherlands, Norway, Poland, Russia, Turkey, United Kingdom, including its Dominions, Crown Colonies and Protectorates, and Yugoslavia; or

(2) For research purposes: *Provided*, That no delivery of polyvinyl butyral for research purposes shall be made except on orders bearing preference ratings of A-2 or higher; *and provided further*, That no person may accept delivery of more than one hundred (100) pounds of polyvinyl butyral in any one calendar month for research purposes; or

(3) Pursuant to specific authorization of the Director General for Operations.

(c) *Miscellaneous provisions*—(1) *Applicability of Priorities Regulations.* This order and all transactions affected thereby are subject to all applicable provisions of the Priorities Regulations of the War Production Board, as amended from time to time.

(2) *Violations.* Any person who wilfully violates any provision of this order, or who, in connection with this order, wilfully conceals a material fact or furnishes false information to any department or agency of the United States is guilty of a crime, and upon conviction may be punished by fine or imprisonment. In addition, any such person may be prohibited from making or obtaining further deliveries of, or from processing or using, material under priority control and may be deprived of priorities assistance.

(3) *Communications to War Production Board.* All reports required to be filed hereunder, and all communications concerning this order, shall, unless otherwise directed, be addressed to: War Production Board, Chemicals Branch, Washington, D. C.—Ref.: M-154-a.

Issued this 14th day of August 1942.
AMORY HOUGHTON,
Director General for Operations.

[Supplementary Order M-154-b]

Supplementary Order M-154-b—(a) *Definition.* For the purpose of this order "methyl methacrylate" means any polymer of the esters of acrylic and methacrylic acid.

(b) *Restrictions on disposition of methyl methacrylate sheet scrap.* Except as otherwise specifically authorized by the Director General for Operations, no person shall sell or deliver scrap resulting from the cutting or fabricating of methyl methacrylate sheets except for the purpose of reprocessing such scrap into methyl methacrylate sheets.

(c) *Miscellaneous provisions*—(1) *Applicability of Priorities Regulations.* This order and all transactions affected thereby are subject to all applicable provisions of the Priorities Regulations of the War Production Board, as amended from time to time.

(2) *Violations.* Any person who wilfully violates any provision of this order, or who, in connection with this order, wilfully conceals a material fact or furnishes false information to any department or agency of the United States is guilty of a crime, and upon conviction may be punished by fine or imprisonment. In addition, any such person may be prohibited from making or obtaining further deliveries of, or from processing or using, material under priority control and may be deprived of priorities assistance.

(3) *Intra-company deliveries.* The prohibitions and restrictions of this order with respect to deliveries of methyl methacrylate scrap shall apply not only to deliveries to other persons, including affiliates and subsidiaries but also to deliveries from one branch, division or section of a single enterprise to another branch, division or section of the same or any other enterprise under common ownership or control.

(4) *Communications to War Production Board.* All reports required to be filed hereunder, and all communications concerning this order, shall, unless otherwise directed, be addressed to: War Production Board, Chemicals Branch, Washington, D. C.—Ref.: M-154-b.

Issued this 14th day of August, 1942.

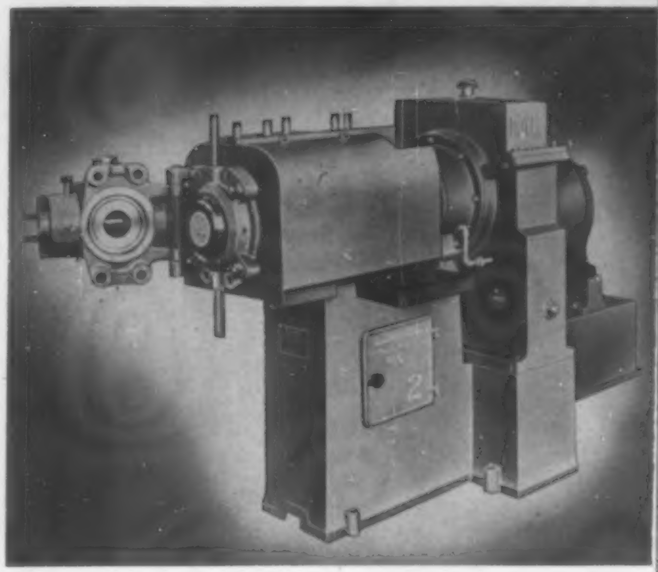
AMORY HOUGHTON,
Director General for Operations.

CONTRACT RENEGOTIATION

The recently created Price Adjustment Boards of the Army, Navy and Maritime Commission have started checking costs and accounting practices of Government contractors to determine if contract prices charged the Government are in line. Plastic molders and fabricators working on Government contracts will be among those probed before the Boards have finished. They have formulated general policies and are attempting now to determine whether profits are exceptionally high.

A check by MODERN PLASTIC's Washington representative with various persons in the Army and Navy has brought forth the following information. (It is put in question and answer form solely because that appears to be the most expedient and most easily understood method. Answers are not to be taken as direct quotations from anybody in the Army or Navy but as a general indication of how the persons charged with contract renegotiation are thinking.) (*Please turn to page 108*)

A JOB TO BE DONE



When a job's to be done, Americans are quick to grasp the yoke. Coordination, ability to hit the mark, are prime requisites.

American industry has shouldered the yoke and is hitting the mark consistently. The far-flung ramifications of the victory program, even though thrown up in haste, are knit into a potent force.

The individual effort demanded from you and us must not confuse the main issue. War orders must be given precedence over others. Your friendly cooperation, shown in the past, helps. It will get the job done.

JOHN ROYLE & SONS

EXTRUDING MACHINES

336 ESSEX STREET   PATERSON, N. J.

NORTON ABRASIVES

A QUICK QUIZ *for* FASTER, BETTER SANDING ?

1 — Am I using the correct abrasives for all sanding operations in my plant?

2 — Have I the right type of coating (Openkote, Closekote)?

3 — Are grit sizes used most economical and sufficiently fast?

4 — Do I need cloth backing?

5 — If so, should I have heavier or lighter material?

6 — Would I do better to get smooth-running, factory-joined belts than to make my own?

7 — Are my machines running at most efficient speed?

8 — Can I convert slow, hand-sanding operations such as burring and hole cleaning to jobs for my portable machines?

9 — Do I know the many ingenious abrasive forms now in use, and the new ones constantly being designed for use on such machines?

10 — Won't I benefit by consulting a Behr-Manning man immediately?

A Behr-Manning Field Engineer will answer questions 1 to 9 for you. When he's through you'll know the answer to No. 10 is "YES."

BEHR-MANNING

(DIVISION OF NORTON COMPANY)

TROY, N. Y.

Dependable Coated Abrasives Since 1872

Q: What will be considered reasonable profits on a Government contract?

A: This is a very difficult question to answer. The term "reasonable" will be construed in the light of getting maximum war production. This does not mean that we will allow excessive profits, but we will allow a sufficiently high margin of profit to be an incentive to increased production.

Q: How about depreciation?

A: We are particularly eager to find out how depreciation is treated. We don't mind a quick depreciation rate if it is justified because of unusual circumstances. But we don't want to pay for depreciation twice in the form of allowing a quick depreciation rate and then charging off repairs at an excessive rate some time in the future.

Q: Will you check profits before or after taxes?

A: We are going to check before taxes; but where unusual situations exist we will listen to the argument of a contractor who would have an unusually low profit picture after taxes because of some abnormal organizational reason.

Q: Is there anything I can turn to to get some idea of how you are determining costs?

A: Yes, there are two things. One is the leading decision TD-5000 which lists allowable costs. It can be obtained from the Internal Revenue Bureau in Washington. The other is a recently prepared booklet called "Explanation of Principles for the Determination of Costs under Government Contracts," prepared by the Accounting Advisory Branch of WPB. This can be obtained for 10 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Q: Will I receive any special consideration because of sub-contracting efforts?

A: You may, and then again you may not. We are going to check to see the extent of sub-contracting and what comparable profits are when work is sub-contracted. Contracting offices frequently take higher sub-contracting costs into consideration when they award contracts.

Q: You say that you would look at profits in light of war production? Can you be more specific and tell me what the factors to be considered will be?

A: Quality of performance will be a big guide. Naturally, we are willing to cooperate more with a quality performer. If the Government had to give a lift in the form of engineering, supervision or drafting aid, we naturally are going to take that into consideration as to what is a reasonable profit. Risk in relation to profits—such as experimentation on new materials or new machinery—will also be given some consideration. Just as in the tax laws, we will check peacetime earnings and profits of the company and capital investment. If profits jump enormously due to the stimulation of the war on items which are no more difficult to make than peacetime items, you can be sure that we will take steps to remedy that situation.

The local military procurement offices throughout the country are circulating letters inviting contractors to come in to discuss the price situation. A very thorough document has been sent out by the Chicago Ordnance District listing 17 questions along the line of cost analysis. Other Ordnance Districts and Procurement Districts are sending out or are planning to send out similar questionnaires. Most manufacturers have shown a desire to adjust voluntarily a contract which has produced excessive profits. Back of this, however, is the statutory power of the Secretary of War to force renegotiation of contracts after examination of a contractor's books and determination of his costs. It was indicated that profits on some Government contracts for plastics had come to the attention of the armed services as possibly being excessive, and are being checked or will be checked in the near future. The War Department official said he felt there would be no difficulty when the matter was brought to the attention of all parties concerned. He declined to say what company was involved, saying that that was of no consequence at this time.

The Government intends to do two things toward paying its share of the burden of war business on a company's facilities. First, it is going to check the company's entire business, determine its overall profits on all Government business instead of taking up each individual contract. The Government agency with whom a company has the greatest dollar volume of business will probably handle the renegotiation of all its Government business. Second, the Government is willing to pay only for facilities actually employed, plus a fair share for stand-by facilities. It will not pay more.

★ MEMBERSHIP OF THE ORGANIC PLASTICS & Resins Manufacturers Industry Advisory Committee was officially announced by WPB. Arthur E. Petersen, former Chief of the Organic Plastics & Resins Section, Chemicals Branch, has been appointed Government Presiding Officer. Members of the Committee are:

John C. Brooks Monsanto Chemical Co. Springfield, Mass.	A. E. Pitcher E. I. du Pont de Nemours & Co., Inc. Wilmington, Del.
H. Krehbiel Catalin Corp. New York, N. Y.	S. W. Putman Dow Chemical Co. Midland, Mich.
I. F. Laucks I. F. Laucks, Inc. Seattle, Wash.	P. C. Reilly, Jr. Reilly Tar & Chemical Corp New York, N. Y.
S. Nixon Nixon Nitration Works Nixon, N. J.	James L. Rodgers, Jr. Plaskon Co., Inc. Toledo, Ohio
E. E. Novotny Durite Plastics Philadelphia, Pa.	L. M. Rossi Bakelite Corp. New York, N. Y.
S. E. Palmer Tennessee Eastman Corp. Kingsport, Tenn.	George Simon American Plastics Corp. New York, N. Y.

At the first discussion held by the committee, the following subjects were on the agenda:

Revision of the M-25 Order.

Increased demand for bonding adhesives for the manufacture of plastic plywood.

Extenders for phenol and urea materials, their permissible use.

Revision of the $^1/_{12}$th clause and other clauses of the M-154 Order.

Short review of the entire chemical supply situation as applied to plastics.

Explanation of the operation of the phthalate and phosphate plasticizer Orders.

Container branch specialist said that container situation is getting so bad that paper bags will be the ultimate answer to containers for molding compounds.

CHEMICAL SOLVENTS

A program for the reclamation of millions of gallons of war-essential chemical solvents and oils has been announced by the War Production Board. It is estimated that over one billion pounds of solvents are now recovered annually. Close to double this amount could be recovered if cooperation of all producers were obtained. WPB conferences with business firms engaged in the reclamation and recovery of commercial solvents indicate that solvent reclamation could be increased from 50 to 75 percent above that.

Solvents which can be reclaimed include a wide variety of chemicals such as alcohols, chlorinated compounds, esters, ethers, hydrocarbons and ketones. Under these general classifications are innumerable specific products including benzol needed to make synthetic rubber, toluol which goes into TNT, naphtha, gasoline and other compounds used in everyday operations of many different types of industrial plants.

The chemicals enter into the manufacture of smokeless powder, linoleum, "glassine paper," artificial leather, impregnated fabrics, awnings, rayon and other fibers, plastics, transparent wrappings, cellulose nitrate and acetate and rubber. Solvents are needed to apply plastics, such as phenolic resins, to other materials. *(Please turn to page 110)*

During the manufacturing process, the solvents may be vaporized into the air or discarded in fluid form. In either case, the chemical is wasted unless steps are taken to remove or reclaim it. This involves the use of special equipment which cleans and refines the chemical and makes it available for reuse. Ordinarily, the process requires treatment of the chemicals through such steps as distilling, centrifuging, filtering, washing, or decanting.

While the most important consideration in reclaiming solvents is that of making available essential chemicals for the war production program, there is also a substantial saving in raw material costs involved. A solvent that cost twenty cents a gallon, for example, may be reclaimed and used again at a fraction of the original cost. A list of reclaimers is available from the Industrial Salvage Section of WPB.

• • •

Phenolic Fabrics—A rating of A-2 has been assigned to orders placed for fabrics suitable for manufacture into laminated phenolic products by an amendment of M-134.

• • •

PRP—Chemicals may now be accepted by companies operating under PRP in greater quantities than authorized on their PRP certificate by the terms of Exemption No. 2 to Priorities Regulation No. 11. The exemption provides that such a company is free to accept delivery of any material not included on Materials List No. 1 of the Fourth Quarter Pd-25A application form even though such acceptance exceeds the amount authorized on the company's PRP certificate. Chemicals were omitted from the Materials List of the Fourth Quarter PRP form.

• • •

PRP—Research laboratories which put into process $5000 worth of metals or more per quarter are required to file under the Production Requirements Plan, according to a recent announcement by Amory Houghton, Director General for Operations. Special instructions for use of research, analytical and testing laboratories in filling out Form PD-25A have been issued by the Safety and Technical Equipment Branch. Class I producers (who put into process $5000 worth of metals in any one quarter) must file under PRP. The plan is voluntary for other producers.

• • •

Alcohol—Order governing distribution and priorities extended indefinitely, effective July 28. (Amendment 5 to General Preference Order M-31 as amended.)

• • •

Ceiling Prices—Effective Aug. 1, a new OPA regulation fixes the maximum price of chemical cotton linters at .0435 cent a pound for grades with 73 percent cellulose content, and a differential of .0009 cent for variations from the basic cellulose content. A price of .037 cent a lb. was set for hull fibers containing 70 percent cellulose with a similar differential on variations. The purpose of this new price regulation is to set a price structure which will conform with the allocation order of WPB and stimulate output of high cellulose cotton linters.

A maximum price for imported cresylic acid has been established by Maximum Price Regulation 192, OPA, effective Aug. 5, of about $1.10 a gallon. The new ceiling price is established on the basis of an ex-British works cost of 70 cents per U. S. gallon for highest quality acid.

• • •

Phenols—Order controlling distribution and priorities extended indefinitely by Amendment 2 to General Preference Order M-27, effective July 28.

• • •

Phthalate Plasticizers—All but small deliveries of phthalate plasticizers are limited to allocations made by the Director General for Operations, beginning Sept. 1, it was announced by WPB recently. Deliveries to one user of 5 gallons or less of each type per month are unrestricted, and deliveries of 55 gallons of any one type or 100 gallons of different kinds to a single user are unrestricted.

• • •

Machine Tool Producers—War Production Board advised machine tool producers on Aug. 10 that an urgency standing should not be used in connection with a Preference Rating Certificate PD-1A. Urgency standings determine the sequence of deliveries of machine tools as between service purchasers of the same group within percentage quotas established according to recommendations of the Army and Navy Munitions Board. According to General Preference Order E-1-b, a service purchaser is one whose preference rating certificate or purchase order shows that the preference rating was assigned by an original Preference Rating Certificate PD-3, PD-3A, PD-4, or by Preference Rating Order P-19-h.

• • •

Materials Scarcity—The fifth provisional report on the relative scarcity of certain materials for war, prepared by the Conservation and Substitution Branch of the Conservation Division, was issued by the WPB on Aug. 21. Materials are listed in three groups, ranked on the availability of existing supplies. Group I consists of materials of which supplies are inadequate for war and most essential uses. Group II consists of materials sufficient for most essential uses. Group III consists of materials of which supplies are adequate for all appropriate types of present demands, including use as substitutes.

• • •

Priorities Supplement—The seventh in a series of supplements to the revised edition of Priorities in Force dated May 31, 1942, was issued on Aug. 21. This supplement adds the priority actions during the period of Aug. 13 to 19. Copies of the booklet and supplements may be obtained from Room 1501, Social Security Building, 4th and Independence, S. W., Washington, D. C.

TAKE AN INVENTORY NOW

The following material has been prepared especially for business magazines by Major General Lewis B. Hershey, U. S. A., Director of Selective Service. MODERN PLASTICS *publishes it, feeling that the information contained therein is vital to every businessman and should receive the widest possible dissemination.*—ED.

In order to keep production going and at the same time furnish men for the armed forces, industry should now establish an orderly replacement program. In order to secure temporary deferments for essential men while he is training women, young men, etc., the employer should know the fundamental principles in the operation of his local Selective Service Board. He should know how many men on his pay roll are between the ages of 20 and 45. He should investigate the classification of every one of those men. On the basis of such an inventory he should prepare to plan ahead and train men for replacement of those who must necessarily enter the armed forces.

Deferments, granted so that employers may train women or men not liable to early induction, are temporary deferments; they cannot exceed 6 months and in many cases may be for only 30, 60 or 90 days.

Employers may seek the deferment of their necessary men with or without their consent. Here is how they go about it. The employer can secure Form 42A at the local board and the local board will consider the employer's request when the form is properly filled out and signed. If such request should be denied the local board will advise the employer of its refusal of such an occupational deferment. The local board does this by sending to the employer, at the same time it notifies the registrant of his classification, a Form 59.

There are ten days after Form 59 is mailed by the local board to the employer during which the employer can appeal the registrant's case. In order to take an appeal the employer simply has to sign his name to Form 59 which he has received, and return it to the local board. When Form 59 is returned by the employer the appeal procedure becomes automatic. If the local board and the appeal board deny the appeal for the occupational deferment of a key man, the employer may then bring the matter to the attention of the State Director at the State Selective Service Headquarters, with the request that the case be reopened or appealed by him to the President.

A good rule to follow: Don't ask deferments for any men who can be replaced by training another individual not likely to be eligible soon for service in the armed forces. Make an inventory.

London Letter

THE British Board of Trade has asked the plastics industry to make 10 million cups and saucers to help meet the very heavy requirements of the civilian population and particularly the numerous canteens which have sprung into existence since the war began. Urea-formaldehyde resin is naturally the material chosen for the job, and the bulk of the cups and saucers will be molded of white resin. Design is strictly utility and the utmost use is being made of existing molds. The Government is concerned wholly with serviceability and not artistry.

During the last three months, there has been a growing controversy in the technical press about the advantages and disadvantages of manufacturing calcium carbide in the United Kingdom. It is rumored that a plant has been set up since the war for the benefit of the metal industries but naturally the plastic manufacturers are concerned about the availability of cheap acetylene for the production of plastic polymers. There is little prospect of this happening owing to the shortage of water power or cheap fuel and the growing difficulty of securing suitable manufacturing plants. If a large shadow carbide plant had been built before the war as an insurance against bad times, Great Britain would, today, be in a favorable position regarding the home production of synthetic rubber and not entirely dependent on American exports. It will be remembered that a carbide manufacturing plant was established in Manchester during the last war but closed down afterwards, owing to the competition of cheaper imported material. Such is the shortsightedness of politicians.

Your correspondent has received several letters from friends in the States regarding the success of the experiment of replacing men by women workers. In the plastics industry there is not the slightest doubt that it has been an unqualified success, and while it was received with serious misgivings at first, today molders and material manufacturers are wholehearted in their praises. More and more women are being absorbed into the workshops and this absorption, while bringing with it several tricky welfare problems, has not lowered production figures.

Some interesting information has just come to hand regarding the shortage of imports of molding powder in India and other British Dominions and the various methods adopted in these several countries to make good deficiencies. One of the methods is of sufficient interest to justify reporting.

In India, where supplies of shellac are very large owing to the difficulty of shipping it to the United Kingdom and the U. S. A., this natural resin is being mixed with finely ground jute fiber and used as an injection molding powder for the manufacture of cheap ornaments and jewelry. This substitute for urea and phenolic materials is naturally somewhat inferior to the synthetic plastics as regards physical properties, but its use does enable the native molding industry to carry on during the war emergency.

Allied to this so-called legitimate plastics industry is the lacquering side of the business; and now that tin can no longer be spared for coating steel plate more attention is being given to lacquers. The container situation in Great Britain today is a very serious one and the canning of vegetables and fruits has had to be very seriously curtailed by the Ministry of Food. Blackplate heavily lacquered is being used to an increasing extent and the vinyl polymers are being employed not only as a basis for some of the lacquers but also for the sealing of the containers.

The British Ministry of Supply is now encouraging manufacturers to devote some research to the question of exploiting for the national interest the vast amounts of sawdust which have accumulated in this country. A good deal of nonsense has been talked about sawdust and the suggestion that it might be treated with synthetic resin and extruded in plank form for the building industry is not received with great enthusiasm by plastic manufacturers. The most promising outlet for sawdust as far as the plastic industry is concerned would appear to be the production of lignin resin which, if cheap enough, would certainly be a very valuable addition to the range of plastics molding compounds.

BRITISH THERMOPLASTICS—CELLULOSE ACETATE

This London Letter is the first installment of a special series describing current conditions in the British plastics industry. Other sections will appear in early issues of MODERN PLASTICS.—ED.

It is a temptation to be eulogistic and indulge in panegyrics concerning the many contributions of the thermoplastic side of the British plastics industry to the armament program; to gloss over failures and disappointments and to give full license to wishful thinking. On the other hand, one must be wary of too realistic or too gloomy a survey. A diminishing glass is just as misleading as a magnifying glass.

At the commencement of hostilities, the plastics industry was not ill prepared, particularly as regards the production of molded cellulose acetate units for the aircraft industry. A number of small shadow factories were already in being, producing many different kinds of pairings, fillets, cockpit enclosures and coverings for airscrews. These contributions proved of great value to the rapidly expanding aircraft industry and every encouragement was given at the commencement to molders and material manufacturers to increase their output and also to design and produce more ambitious units—that is, units of larger dimension. Unfortunately, this first enthusiasm had to be dampened down a good deal owing to the somewhat disappointing or unreliable performance of many of the stressed acetate units under strenuous operational conditions, particularly in overseas theatres of war.

The failure of cellulose acetate to stand up consistently to gruelling service conditions was due mainly to the tendency of the 1939 material to undergo dimensional changes as the result of exposure to widely fluctuating operational conditions—humidity, alternating rise and fall of temperature, vibration, etc. It was not fully realized at first that cockpit enclosures are subjected to extremes of temperature which are likely to cause serious shrinkage, or at any rate differences in width, breadth or thickness sufficient to cause buckling and distortion. Another factor overlooked by technicians in those early days was that crystallization, accompanied by a lowering of the mechanical properties, may be induced by sub-zero temperatures. Time has clearly shown that the impact resistance of the material and also effect of vibration, etc., at room temperatures bears no relation to the resistance of the specimen at very low temperatures. Low temperature was found by aeronautical experts to be particularly severe on joints where there was likely to be a slight excess of plasticizer or solvent present.

Early operational experience with large acetate fairings made it patently clear that in designing and manufacturing two factors were not taken into sufficient consideration, namely, cold flow and creep. It was not fully realized in 1939–40 that the ability of the molded part to retain its shape under all operational conditions of service is not only dependent upon its resistance to distortion under heat and shrinkage due to moisture absorption, but also upon its resistance to creep and cold flow, particularly at temperatures in excess of 80° F. The larger the size, and therefore the greater the weight of the moldings, the heavier the load and the greater the liability of deformation above normal room temperatures.

The plastics industry suffered at the beginning of the war from the fact that there was no well-planned or well-directed plastics aeronautical research. The scientific work carried out by independent firms or organizations was not coordinated and there was no real policy shared by the two industries, plastics and aircraft. As the result of the somewhat unfavorable experience with large cellulose acetate units (*Please turn to page 114*)

and the critical attitude of the newly developed non-ferrous industry the aircraft manufacturers adopted a ca'canny attitude. They placed the onus of plastics expansion and development entirely on the plastics industry.

In spite of considerable opposition from without the plastics industry, and diminishing output within owing to the cessation of European acetate supplies, the home industry made renewed efforts to give satisfaction, both as regards quantity and quality. Research was stepped up and new plants erected. Of particular interest is the fact that a cellulose acetate containing an increased acetyl content was developed which possessed greater resistance to high humidities, hot water and dry heat and also improved dimensional stability. Particular attention was at the same time given to the production and use of better plasticizers—that is, products which could not easily be leached out of the plastic and which gave it more permanent properties. Of considerable potential interest was the reinforcement of cellulose acetate sheet material with metal so as to obtain a product with the fluxural stiffness of duralumin sheet. The metal used consisted of a thin metal (stainless steel) sheeting pierced in a special manner so as to obtain excellent bonding to any thermoplastic sheet. This metal sheeting is particularly useful for making what are otherwise very awkward corners between sheets. The sheeting is extremely versatile and may be used to make a "sandwich" material, or acetate covered on both sides with metal. It is also practical to make a special flush finished hinge which allows ready access to landing lights in the leading edge of wings, where a flush finish is of the highest importance.

Every effort was and is still being made to increase the usefulness of acetate material and to meet the growing competition of other thermoplastics, particularly acrylic and vinyl resins, the output of which has been very greatly increased. Of interest is the stepped-up output of extruded acetate tubes for aeronautical applications. Attention has also been given to the improvement of fabricated acetate units by spraying on surface protective coatings, particularly solvent solutions of vinyl resins or cellulose acetate, etc. The former type of plastic is found to be useful on account of the excellent physical properties of the film and high resistance to solvents, such as gasoline and oil, and also to moisture. Experiments undertaken with the Schori dry powder gun have shown promise owing to the fact that the resin can by this means be deposited on the surface of a molded acetate unit free from solvent and containing absolute minimum of plasticizer.

Today the cellulose acetate section of the thermoplastic industry is very much alive and kicking, having profited considerably from its early experience. The innate weaknesses and limitations of the material are now fully realized and the present tendency is to concentrate on smaller rather than larger units so that, while the amount of cellulose acetate per service plan tends to become larger, the individual acetate units are smaller. (*Mailed Aug. 3, 1942, by Mrs. John S. Trevor.*)

Methacrylates in surgery

(*Continued from page 57*) trimming of the bone of the femoral head. In Fig. 3, the smooth appearance of the femoral head after being beneath a cap more than a year is shown. As a general finding, about 50 to 80 grams of bone need to be removed in order to allow the head of the femur to rotate freely within the plastic cup. If motion is not free within the cup, and if the cup itself does not rotate freely within the hip joint socket of the pelvis, postoperative mechanical difficulties are likely to follow and the operation not be successful. Following the procedure the patient's course can be checked by serial observation with the roentgen ray. The fact that the plastic cups are transparent to the roentgen ray aids the surgeon in following minute bone detail in the hip. This is in contrast to the opaque cup shadow of a metallic appliance, where it is not possible to follow the changes in the femoral head after it has been remodeled at operation.

The results as given before (80 percent good and excellent) in this series of osteoarthritic hips are the evaluations of the function at the operated hip more than a year following operation, and have been determined upon the patient's walking gait, and accurate measurement of motion at the involved hip joint. As far as the patients are concerned, such a result is far better than the alternative procedure of stiffening the joint, formerly used by surgeons to alleviate pain in this condition prior to the introduction of this operation. It should be pointed out that prior to the introduction of foreign body cups for arthroplastic procedures, new bone taken from the patient's own thigh was utilized to cover the raw femoral head. This procedure was never so satisfactory as use of the plastic hemispheres has been. Further, the latter operation is simpler for the patient and convalescence is more agreeable and shorter

7—A plaster cast has a methyl methacrylate window through which wound can be examined without taking off the cast

Chronic arthritis of other joints

The only other joints in the body where a similar mechanism exists and where the cup principle can be applied are the small joints of the knuckle region of the hand and the temporo-mandibular (jaw) joints. Smaller methacrylate cups have been used in these joints with complete success. In the knuckle joint, the mechanism of motion involved is the reverse of that of the hip joint. In this smaller joint the neighboring bone rotates above the convex surface of the hemisphere. Roentgenograms of this same joint following the application of a hollow hemisphere show the widening of the "joint space" as compared with the x-ray taken prior to operation. Such a change simulates a restoration to the normal in that, in the normal hand, such a "joint space" exists, filled with cartilage, which substance serves as a cushion between the bone ends and provides for smooth motion. In the arthritic patient, joint cartilage may become worn away to such an extent that bone surfaces come in contact and produce pain. Substitution of methacrylate plastics appears to be the easiest and best imitation of the normal, since plastic operations in the adult and aged have never yielded good results in these small joints of the hand.

Other operative uses for methacrylate

Plates and tubes of methyl methacrylate have had a limited use by the surgeons of our department in bone grafting, as a substitute for metal plates. Metallic plates and screws placed within the body have never been wholly satisfactory until the recent production of inert alloys, so that

the use of inert methacrylates would appear to be a logical substitute. Not enough cases have been done by us to warrant a summary of these applications in the medical literature, so that this use will be merely mentioned and illustrated in this place. Figure 4 shows the use of a methacrylate tube to hold a free bone transplant between the ends of the shortened and recipient bone. Union will take place in a few weeks and, at a future date if necessary, the plastic tube can easily be removed by a motor saw. In Fig. 5, some plastic bone plates utilized in certain types of hip fractures are shown. It should be pointed out that only metallic screws can be used for fixation of these plastic plates in fractures, since screws made of plastic shear too readily. Fixation with plastic plates is rigid if two plates are used; and since rigid internal bone fixation allows early mobilization of joints and diminished disability due to this cause alone, this type of fixation represents an advance in the technique of bone surgery.

Materials prepared from methacrylate plastics, because of their clear appearance and their non-irritating properties, will become adapted to many other fields. For example, spheres of methacrylate (see Fig. 6) have been prepared to be used following evisceration of the eye contents, a procedure commonly practiced in opthalmic surgery. In the past the gold and silver spheroids used for this purpose were too heavy, while glass spheres have been known to break under sudden stress and under conditions of excessive heat. Other prostheses such as skull plates to cover operative and traumatic defects in this structure, and prostheses to be used in other types of plastic surgery will undoubtedly be adopted in the future.

External use of sheet plastics

The reader must not assume that the applications of methyl methacrylate are limited to situations where the plastic device can be inserted within the body. For several years, molded methacrylate splints (which are transparent to the x-ray) have been utilized to support extremities both as emergency splints and in actual treatment of fractures. The author prefers not to use ready made splints in treating fractures, but has on occasion used warmed ribbon sheets of cellulose acetate in making light casts. They are more expensive than plaster and more difficult to apply, but can easily be cleansed and are light in weight. The use of the nitrocelluloses and cellulose acetate in the manufacture of orthopaedic jackets and certain types of braces is likewise well known. Sheets of transparent methacrylate are conveniently used as a cast window (Fig. 7), to allow the surgeon a continuous view of the wound without the necessity of opening the cast. This latter is desirable because many wounds heal better when undisturbed by repeated dressings.

Summary

The recent application of molded sheet methacrylate for the purpose of relieving arthritic joints and thus achieving improved function and relief from pain in these joints is described. Eighty percent "good" and "excellent" results has been reported by the author in a series of cases of osteoarthritis of the hip. These plastic joint prostheses have the positive advantage of being transparent to the x-ray and in addition are non-irritating within the body, thus relieving pain. The material can be made sterile before use, and is resistant to water and alkalis. Tough and rigid, the cups will hold their dimensions once they are formed. In different sizes, the plastic cups can also be utilized in a few other joints in addition to the hip joint.

Plates and tubes of methacrylate have been used in bone grafting operations and in the open operative fixation of certain fractures requiring open surgical attack. Spheres of the substance can be used in the eye and in many other places in plastic surgery. In addition, many uses for plastics have already been found in the manufacture of external appliances.

Credits—Material: Plexiglas, Lucite. Fabricated by Croasdale and de Angelis.

REFERENCES

[1] Bellas, J. E., "Suture Studies: A New Suture," Arch. Surg. *41*, 1414 (1940).

[2] Smith-Peterson, N. M., "Arthroplasty of the Hip, a New Method," Jour. Bone and Joint Surg. *21*, 269 (1939).

[3] Harmon, P. H., "Arthroplasty of the Hip with Lucite Cups," Proc. Inst. of Medicine of Chicago *13*, 413 (1941); Guthrie Clinic Bull. *11*, 9 (1941).

[4] Harmon, P. H., "Results during the First Year Following Hip Arthroplasty with Non-metallic Foreign Body Cups of Methacrylate Plastic: Pathogenesis and Operative Technique," Guthrie Clinic Bull. *11*, 124 (1942).

[4] Harmon, P. H., "Arthroplasty of the Hip with Non-metallic Foreign Body Cups of Plastic," Surgery, Gynecology and Obstetrics, 1942. (In Press.)

Scarfing joints in plywood

(*Continued from page 75*) scarfs. In addition, paper masks should be used over the scarfed area and on both sides of the plywood to prevent adhesion to the hot plates or cauls.

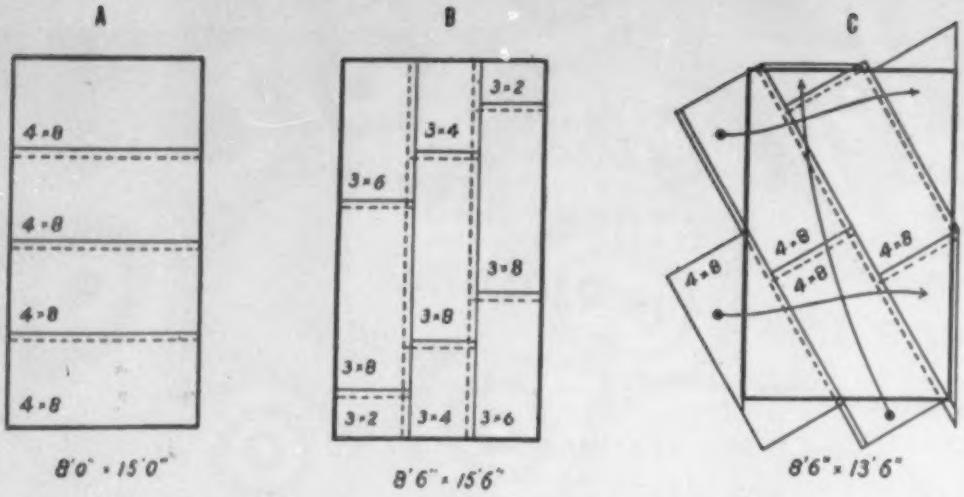
Many manufacturers employ a liquid phenol-formaldehyde resin which can be applied by brush or spray to both faces of the bevel. The first application usually soaks into the wood and fills up the exposed end grain of the slanting area, providing a normal bonding surface. A second application of the liquid resin, or a sheet of resin film, is usually desirable. The surplus solvent must be allowed to evaporate to avoid the hazard of steam blisters in hot pressing. Paper masking is essential again to keep the resin away from the hot press plates and the cauls.

In some instances, urea-formaldehyde resin adhesives may be adequate, although they will not be so durable as the phenol-formaldehyde adhesives.

Bonding scarfs with heat

The process of curing the scarf joint using the resin adhesives described above requires the application of adequate heat and pressure over a relatively narrow area, but one that will accommodate the longest joint necessary to combine the smaller plywood sheets into the final aggregate size. A typical sketch of such a press is shown in Fig. 3. Note that the corners of the hot plates are distinctly rounded to prevent marking the plywood. It is important that rigid clamp members be placed on both sides of the pressure-heat area, so that the plywood halves can be gripped firmly and no slippage occurs, while simultaneous heat and pressure are applied to cure the resin in the scarfed joint. This emphasizes the importance of a blunt, thin toe to ride over the thicker heel, both to safeguard against slight slippage and to compensate for the small amount of compression that takes place under combined heat and pressure. This is of the utmost importance to avoid a thin spot at the scarfed joint. The sketch in Fig. 3 suggests a supporting table at both ends of the scarf bonding unit. This is for the purpose of keeping the whole plywood area flat during bonding, since drooping plywood ends would prevent the accurate placement of the beveled areas in the scarf joint.

The heat may be supplied by steam, as in a standard hot press, or by electrical resistance units incorporated in the hot



4—Three examples of different types of scarf bonding are shown here: A—All joints run in one direction. B—Joints staggered to maintain uniform distributed strength. C—Angle joints suitable for large sheets of plywood which are to be curved or bent. This arrangement prevents straining any one joint continuously

plates, functioning much as an electric flatiron does. Still another possible method of applying heat in a scarf-bonding press is by means of a high frequency electrostatic field, using the press platens or metal cauls, properly insulated, as the electrodes. This method promises to be most useful in bonding thick assemblies, where heat penetration difficulties may otherwise be encountered. Metal cauls are used frequently, both to protect the hot plates and to reduce the chance of marring the plywood with the corners of the hot plates.

The ordinary hot press is not generally satisfactory for scarf joint work, since it is impossible to observe whether the beveled surfaces are in proper alignment and contact. Adequate clamping of the plywood to prevent slippage during the pressure interval of the bonding cycle is also difficult. Still further, there are serious complications in attempting to use more than one opening for scarf jointing, and such a limited use of a hot press is likely to be uneconomic.

After the scarfed jointed plywood has been removed from the bonding press, it is often desirable to spray the heated area with water to restore quickly its normal moisture content and thickness. Stacking the panels flat with adequate stickers in ordinary factory temperatures will accomplish the same result in two or three days.

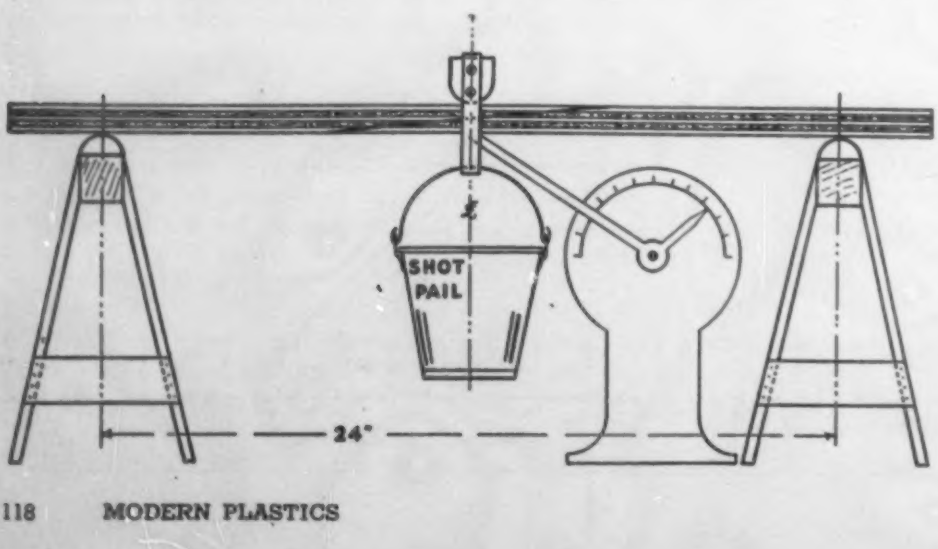
Bonding scarfs without heat

While the preferred method of scarf jointing and bonding in most cases utilizes combined heat and pressure to cure the resin, there are instances where this is not feasible. In such cases a cold setting urea-formaldehyde resin may be found satisfactory for the cold bonding of the scarf joints. One limitation of the cold bonding process, however, is the necessity for applying pressure within a relatively short time after spreading the adhesive. Otherwise the technique is essentially the same and all the precautions noted should be observed. Since heat facilitates wood compression, its absence will make this factor less important.

Arrangement of multiple sheets

It is important to give careful consideration to the arrangement of sub-units in the large aggregate areas of plywood, and several combinations are suggested in Fig. 4. If one dimension of the plywood is large enough, they may be put together as in Fig. 4 (A), pre-arranging the grain direction in the individual sheets as may be required in the final large sheet. If both dimensions are inadequate, a suggestion is found in Fig. 4 (B), where only the longitudinal scarfed joints are continuous, and the transverse joints are staggered to keep the distributed strength as uniform as possible. When the large sheets of plywood are to be bent or curved on an axis parallel to either end or edge, the arrangement of Fig. 4 (C) may be preferred to avoid straining any joint continuously. It is to be noted that provision for the use of odd triangles is made, resulting in a minimum of waste.

In any of these arrangements, the dimensions of the plywood will be foreshortened by the amount of lap in the scarf. Usually it is not desirable to trim the plywood to final dimension, nor to sand the surfaces until the scarf joints have been completed. (*Please turn to page 120*)



5—A simple test for determining strength of scarfed joints is demonstrated here. The end supports are slightly rounded, and the scarf is placed centrally between the supports. The weight, consisting of a pail of shot, is supported from a rounded block extending beyond the edges of the plywood

ANOTHER SCIENTIFIC INSTRUMENT by Cruver
CRUVER MFG. CO. CHICAGO, ILL.
ASS'Y. DWG. NO. 1150
Cruver
MANUFACTURING COMPANY
CHICAGO
2456 W. JACKSON BLVD.
Seeley 2434
NEW YORK
2 WEST 46TH STREET
Wisconsin 7-8847
Printing Department
Press Printing Department
Department—Hand Operations
Laboratory
Tool Department
Spraying Department
Modeling Department
Inspection Department
Extrusion Molding Department
Foil Stamping Department
Engraving Department
Conveyor Assembly Lines
Assembly Department—Machine Operations
Polishing Department

Testing scarfed joints

Simple tests on flexure strength of scarfed joints can be devised readily, and have definite comparative value. No standard tests for scarfed joints have been established as yet. One of the simplest methods is to prepare narrow strips (such as 2 in. by 30 in.) of normal plywood and scarf-jointed plywood parallel, perpendicular or at an angle to the grain. These strips can be placed over end supports, 24 in. apart, and loaded with concentrated or distributed weights, while the deflection is measured and noted. The distance between supports can be varied according to the thickness of the plywood. The end supports should be rounded slightly and the scarf placed centrally between the supports. The weight should be supported from a rounded block extending beyond the edges of the plywood. A pail of shot is a convenient arrangement for applying weight. A diagrammatic sketch is shown in Fig. 5. Such tests can be carried to destruction and the ultimate strength of the scarf joint determined in terms of normal plywood or normal solid wood. Such tests have a comparative value to determine the percentage of strength obtained, or to detect possible weaknesses and thus develop improvements in scarf design. Accurate bending or flexure determinations will require more refined equipment.

Molding the Thunderer

(*Continued from page 43*) These have been overcome by dint of continuous experiment and persistent hard work; and by using a steam-heated die the molder has been able to get $2^1/_2$ shots a minute. His capacity is 10,000 whistles a day.

For the Thunderer job, the plant's engineering department designed an 8-cavity mold to be used on a 4- or 8-oz. injection molding machine. In planning their mold, the engineers gave particular thought both to the appearance and to the tonal qualities of the finished whistle.

The whistles are molded in two halves, four at a time, with matching halves on opposite sides of the central runner (see Fig. 1). Holes are molded-in for the brass assembly devices: a tubular rivet through the body and a grommet in the shank. In one half of the whistle, two tiny dowels are located at the upper (or blowing) end, and one is placed just above the grommet. These three form a seating for the matching half, which has been given complementary cavities. "U. S. Army," legibly embossed on one side of the whistle, is an integral part of the die.

4—The phenolic whistle as it comes from the compression press, with assembly devices, cork ball and hook and chain

PHOTO, COURTESY PLASTICS, INC.

A $^9/_{16}$ in. diameter cork ball is placed in the cavity of the whistle when the halves are assembled; and when a black oxidized steel chain and hook are attached to a split ring passed through the shank eyelet, the Thunderer is ready for blowing.

The cellulose acetate butyrate selected for the whistle possesses an excellence of weld within the molded piece which makes it exceptionally tough. Its dimensional stability is good, its water absorption low, and it will not shrink nor distort under variations of temperature and humidity.

Another plastics firm, also presently in production on Thunderer Whistles, is molding them of thermosetting material as originally specified by the Quartermaster Corps. Although both the making of the mold and the molding of the piece were initially accompanied by a series of technical difficulties, these were ironed out in due time. Using compression presses and an 8-cavity mold, the company is now turning out 3800 whistles a day, working in three shifts.

Also molded in two halves and fastened together by rivet and eyelet, these Thunderers are of a medium impact phenolic which is strong, hard, resistant to heat, water and organic solvents. Phenolic whistles are difficult to ignite, remain unaffected by sunlight and are slow to deteriorate (Fig. 4).

The shiny black finish of both the phenolic and the cellulose acetate butyrate contributes to the trim appearance of the assembled signalling unit, which not only looks as businesslike as it did in the days when copper was plentiful but hangs less heavily on the whistler's lip.

Credits—Material: Tenite II and Indur, molded, respectively, by Plastic Engineering, Inc., and Plastics, Inc.

One-piece gage face

(*Continued from page 73*) faces did not crack or chip under these severe tests, they were then accepted for field test. Several hundred gages, equipped with the plastic face, were placed in service in all parts of the country and in all types of service. This test showed a new difficulty which had been overlooked previously. The acrylic resin compound was found to have an after-molding shrinkage of from .008 in. to .012 in. per inch over a period of six months to a year. However, when the materials manufacturer developed a new type resin, carefully accelerated aging tests showed less than .001 in. per inch shrinkage over a period of four weeks, which was estimated to be equivalent to over two years' actual use.

After the design and material had been adjudged satisfactory, two cavity injection molds were constructed for the additional three standard sizes. During the past three years many thousand gages equipped with this plastic face have been shipped to all parts of the world and are at present giving such excellent service that the gage is called the "Durafront" because it eliminates the annoyance of broken gage glasses. The plastic face has also made the gage easier to read.

As practically all threaded gage bezels were previously made of cast brass, this new Durafront has resulted in a saving of over 100,000 lb. of brass. It has also reduced the man and machine hours necessary to machine and thread these bezels by over 10,000 man hours. These savings are for a period of somewhat less than 3 years and for 4 sizes of gages only.

Credits—Material: Crystalite. Molded by Mack Molding Co. for Ashcroft Gauge Division, Manning, Maxwell & Moore

Difficult shapes . . . long runs are easier with molds and hobs of

DISSTON STEEL

Whether your problem is a mold for some unusually intricate product . . . or a mold to produce many thousands of identical parts in your high-speed machines . . . you'll find the right answer in one of the four Disston Steels specially made for the plastics industry.

If you *use* molds and hobs, you'll find it profitable . . . in fewer rejects and faster output . . . to specify Disston Steel.

If you *make* molds and hobs, you'll profit equally because these four Disston Steels are uniformly sound, with no hard spots or spongy areas.

- **DISSTON PLASTIRON** is a clean, soft iron that carburizes easily and produces smooth cavities. Best adapted to difficult shapes and short runs.
- **DISSTON PLASTALLOY** has great core strength and abrasion resistance, yet is easy to hob. Cavities are tough and resist wear.
- **DISSTON NICROMAN** is an ideal steel for forces, punches and machined molds because of its extreme toughness, resistance to abrasion and long life.
- **DISSTON CROLOY** combines uniformly high hardness, compressive strength and wear resistance with superior core strength. Your best choice for long runs and extremely accurate part production.

Do *you* have a problem involving mold and hob steels? Our metallurgists will be glad to work with you in finding the best solution. Write to Henry Disston & Sons, Inc., Philadelphia, Pa., U. S. A.

DISSTON

MOLD STEELS . . . HOB STEELS

It can hardly help it—when the plastics now being developed are given their part in rebuilding civilian life.

—With new molding techniques that combine metal and plastics in the most intricate assemblies,

•

—with a hardness range from a plastic with full rigidity to one so strong and pliable it can replace leather.

•

—with color range from solid black through every hue and tint of the rainbow to crystal so clear it can be used for lenses,

•

—with adjustment to heat, cold, oil, acids, impact and high dielectric almost at the perfect stage,

•

—with the possible size range for molded pieces rapidly nearing suitable proportions for the manufacture of autos, boats and planes,

•

—yes, with properties like these, and infinitely more on the way, the post-war world will "go plastic"!

•

Right now, however, please

SEND US WAR WORK

for estimates on designing, engineering, mold making, molding (compression, transfer, injection), and assembling. Along with this service —with an eye to "things to come"—we will be glad to help you to

Plan With Plastics!

Waterbury Plastics

THE WATERBURY BUTTON CO.
WATERBURY, CONN., U. S. A.

WBCo

EST. 1812

Low pressure laminating

(*Continued from page 47*) temperature for one-half to one hour, the mandrel is removed. Thus the ultimate production per machine will depend largely on the number of mandrels which are made up for each particular job.

The same basic resins which are used in the rolling operation are also used in fabrication after curing. It has also been found possible to impart a mirror finish to the inside surfaces of the shells with these same resins. The shells themselves are easily finished or machined, in addition to possessing desirable strength characteristics and moisture resistance.

After considering the fabricated materials and methods for both types of laminating, therefore, it is seen that the low pressure methods have a distinct advantage both in equipment cost and in speed of getting into production. Low cost, relatively simple molds, coupled with the fact that treating machines and costly press equipment are unnecessary, make low pressure techniques seem particularly attractive. On the other hand, the large amount of hand labor and special techniques involved in low pressure work make large scale production very difficult. Thus it would seem that if a small number of parts is required in a hurry, disregarding other factors, low pressure laminating would be the logical approach. Of course, it must be remembered that in many instances the parts could be fabricated only by low pressure methods.

The properties resulting from low and high pressure laminating vary considerably. As one would naturally expect, lower laminating pressures mean less compression, poorer bonding and lower gravities. As a direct result of these properties, the moisture absorption of those parts not specially treated to resist moisture is higher. On the other hand, lower pressures in combination with lower curing temperatures mean less distortion or rupturing of the laminate fibers, hence a much more efficient utilization of the fibers as far as strength values go.

In Table I, the physical and mechanical properties of regular Grade C laminated have been compared to a canvas cloth phenolic and an airplane tape phenolic, both laminated at 3 lb. per sq. inch. The canvas duck product presents a direct comparison with the high pressure laminate, while the airplane tape product shows what the effect can be if the fabric employed initially possesses inherently stronger properties.

The canvas base material has essentially the same tensile and flexural strength as Grade C, but the compressive strength is roughly half. The same properties hold for the airplane tape, except for the larger tensile strength which is to be expected. The moduli of elasticity of both low pressure types are lower than that of Grade C; but here the airplane tape shows its superiority since its modulus is 3 times that of the canvas base, while it is approaching the range of Grade C. Again on Izod impact, the low pressure laminated canvas base material is approximately half as strong as grade C, while the airplane tape has a value of roughly twice that of grade C.

The effects of increasing the laminating pressure within the low limits specified in the beginning of the article has been shown in Table II for the same basic canvas cloth phenolic described in Table I. In the range from 3 lb. per sq. in. pressure to 75 lb. per sq. in. pressure, the tensile and compression strengths have remained approximately the same, the flexural strength has increased 27 percent and the modulus of elasticity has increased $3^1/_2$ times. The Izod impact is larger at the higher pressure while, along with increasing gravities, the moisture absorption has been reduced about 39 percent. Consequently, although the properties are generally much better at the "higher" low laminating pressure than at the lower value, the proper balance between degree of strength superiority and increased costs resulting from higher laminating pressures must be considered.

Generally speaking, therefore, low pressure laminating produces a type of product which compares favorably in most properties with high pressure lamination, but is deficient particularly in modulus of elasticity and compressive strength. The greater compression of the high pressure laminating produces better bonding, higher gravities and increased water resistance. However, those laminates which do not bond well under high pressures, such as Fiberglas, are no less poorly bonded under low pressure. Most of these conclusions have been based on phenolic resin combinations, but the same general characteristics apply to urea and modified urea uses.

The lower values, which are exhibited in some properties of low pressure laminates, raise the question of whether or not these values would be objectionable on applications in which they do not play too important a part. In other words, is it not practical to build a part around certain characteristics which it will need in the field, instead of developing a general,

Table I.—Strength Values of High and Low Pressure Laminates

Property	Grade C laminated	Canvas cloth phenolic laminated at 3 p.s.i.	Airplane tape phenolic laminated at 3 p.s.i.
Tensile strength, p.s.i.	10,000	10,100	14,350
Flexural strength, p.s.i.	20,000	14,700	14,800
Compressive strength, p.s.i.	40,000	20,300	17,550
Izod impact (edgewise), ft.-lb./in. of notch	4.6	2.3	8.17
Modulus of elasticity, p.s.i.	500,000 to 1,000,000	113,000	345,000
Resin content, percent	45–50	48	40
Specific gravity	1.36	1.13	1.07
24 hr. H_2O absorption, percent (untreated surfaces)	1.5	11.8	11.2

Table II.—Effect of Laminating Pressure on Canvas Cloth Phenolic

Property	Laminated at 3 p.s.i.	Laminated at 30 p.s.i.	Laminated at 75 p.s.i.
Tensile strength, p.s.i.	10,100	9,990	11,100
Flexural strength, p.s.i.	14,700	16,300	18,600
Compressive strength, p.s.i.	20,300	17,000	20,250
Izod impact, ft.-lb./in. of notch	2.3	1.85	4.17
Modulus of elasticity, p.s.i.	113,000	334,000	404,000
Specific gravity	1.13	1.16	1.20
24 hr. H_2O absorption (untreated surfaces)	11.8	7.15	7.5

all-purpose material? What if a fabricated part does absorb 10 percent moisture? If the dimensional stability is satisfactory and the added weight is not a disadvantage, the part should be practical. Since most of the proposed parts are nonstructural or semi-structural in nature, they could be designed to stand the probable stresses involved, while sacrificing some of the others. A purely hypothetical example would be a cowling or duct containing a layer of asbestos cloth on the inside for heat resistance, a core of cheap, low resin impregnated cloth for general impact resistance, some Fiberglas cloth reinforced sections where stresses may be concentrated, and an outside layer of fine cloth or paper for appearance and moisture resistance.

As has been stated before, the aroused interest in low pressure laminating has been forced upon us by war circumstances. The primary purpose at the present is to prepare metal replacement parts as quickly as possible in any way that is at all feasible. Thus the low pressure technique has already gained a foothold, whereas it probably would have taken years under ordinary circumstances.

This type of work requires considerable ingenuity and foresight on the part of the engineers in charge. Each job must be considered as a project in itself. In fact, many of the best results to date have been accomplished by persons who have had little or no laminating experience. They have done it simply because they didn't know it couldn't be done.

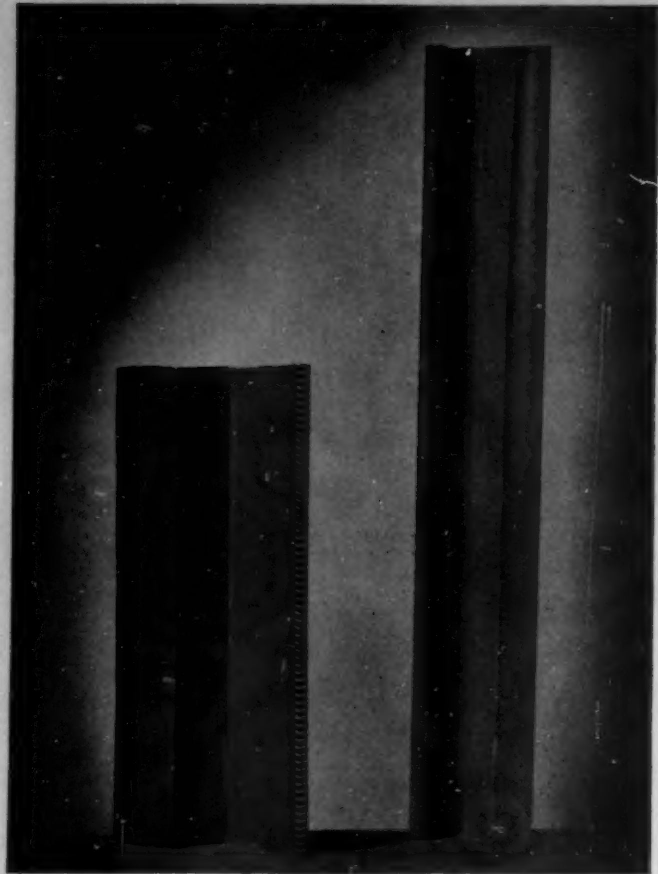
At the present, some production parts being made in small quantities are doing the job they are supposed to do, although they are far from perfect dimensionally or structurally. Properties which low pressure laminates will probably be called upon to exhibit in the near future are stability under wide temperature ranges, adequate bearing strength, tensile strengths of 30,000 p.s.i., modulus of elasticity as near 3,000,000 p.s.i. as possible, and adequate vibration and moisture resistance. There is every reason to believe that improvements in materials, methods and design will solve the problems in the same way that many much more difficult problems facing the plastics industry have been solved in the past. In fact, the extensive use of low pressure laminates as structural members is not too remote a possibility.

Low pressure laminating is solving a problem now because of necessity. However, it possesses enough desirable qualities to insure its permanent place in laminating after the present crisis is over.

Wide extrusions

(*Continued from page 44*) production feat lies in perfect heat control and in proper die design. Dimensional stability

3



3—Some profiles of extrusions of the vinyl material which show their range of sizes and shapes. These are .020 in. thick and from 5 to 6¾ in. wide. 4—Colored like weathered copper, lengths of the extruded vinyl resemble metal

of the cooling material is achieved through the use of plywood jigs cut to the interior measurement of the profile. These jigs are placed in series near the end of the extruding machine and just before the extruded strip passes on to the pick-up belt.

Blowers spaced at regular intervals pour cool air on the plastic as it advances down the conveyor in continuous progression. Uniform cooling is assured in this manner and distortion is avoided. As the flashing moves off the end of the belt at a speed of 9 or 10 feet per minute, an operator with a pair of shears and an 8-foot ruler cuts it into such sections.

The material is then packed in corrugated containers and shipped to its destination. Besides releasing huge quantities of copper for the war effort, these extruded plastic profiles offer a substantial saving in shipping and installation costs. Great tensile strength of the vinyl material enables it to be extruded in gages comparable in thinness to the former copper material. The difference in specific gravities—about 8.91 for copper to 1.35 for the vinyl—makes for simpler packing and shipping and easier handling.

Application of the vinyl flashing is similar to that of copper. There are many ways of applying both the flashing and the eave cap stripping. On a parapet roof edge the cap stripping is sealed at end joints with cement or a caulking compound. Cap flashing is also used around monitors and at fire walls. The main task is to create a waterproof, weatherproof seal, and a drain between two units, and this the plastic material does.

Credits—Material: Vinylite. Extruder: Carter Products Corp.; Manufacturer, Keystone Flashing Company. Product marketed under the trade name Plasti-Flash

FOR STRENGTH

FILLERS

* Modern Plastics require increased impact, flexural, and tensile strength.

* Our "Filfloc" and "Fabric Filler" types can give you these properties.

* We are at the service of any company interested in processing special fibres.

Send for Samples

Rayon Processing Co. of R. I.

Central Falls Rhode Island

BARCO

SWIVEL JOINTS FOR

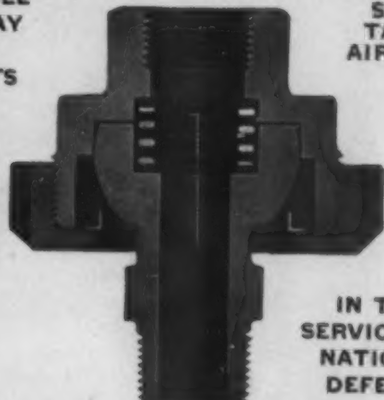
HYDRAULIC PRESSURE

Swivel 7S-8BS

SINGLE—DOUBLE AND THREEWAY PASSAGE SWIVEL JOINTS

SHIPS TANKS AIRCRAFT

Swivel 7AS-8BS



IN THE SERVICE FOR NATIONAL DEFENSE

Available side movement on ball seat relieves all piping strains. Rugged and simple in construction, easily maintained.

Barco Manufacturing Co.
NOT INC.
1809 Winnemac Avenue
CHICAGO, ILL.
In Canada, The Holden Co., Ltd.

THE entire resources and facilities of Michigan Molded Plastics are completely mobilized and in action twenty-four hours a day molding plastics to precision specifications for America's war-winning production—meeting the exacting requirements for the army, navy, and air forces.

CUSTOM MOLDING
• Compression • Injection • Extrusion

M

MICHIGAN MOLDED PLASTICS, INC.

Dexter, Michigan

SINCE 1918

PLASTIC MOLDS

HAND
AUTOMATIC
SEMI-AUTOMATIC
and EXTRUSION to the LATEST METHODS

Designers and builders of all types of PLASTIC MOLDS.

Serving most of the leading molders in the country!

Our 1500-ton hydraulic Hobbing Press adds many advantages in obtaining lower mold costs.

Estimates on request.

EAGLE

TOOL & MACHINE CO.

37–39 Freeman St. Newark, N. J.

Phone: MARKET 3-1572
-1573

ASTM mar resistance test

(Continued from page 85) of light incident upon a mirror at an angle of 45° is reflected specularly at 45° and its polar distribution will have the shape of curve $AA'A_2$. If the mirror surface is disturbed by abrasion, progressively more light will be scattered on either side of the specular beam, and the light-distribution curve assumes the shape $BB'B_2$, approaching the uniform distribution shown by curve $CC'C_2$, which is characteristic of a nearly perfect diffusing surface such as magnesium carbonate. If a lens is placed in the path of the reflected beam and the image of the illuminated spot focused on a photoelectric cell and readings of the intensity taken at the specular angle I_1 and at an angle I_2, 15° from the

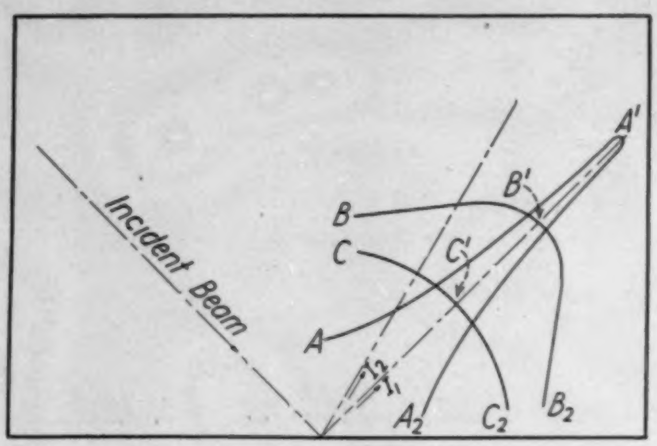


Fig. 4—Glossmeter

specular angle, then the ratio of the readings is a measure of the sharpness of the peak of the light-distribution curve or a measure of the gloss. The angle of 15° off specular is selected because with the prescribed glossmeter the specular beam from a mirror surface just misses the opening of the collecting lens.

NOTE. For strict comparisons of mar resistance characteristics, materials of nearly similar reflectance values should be used, for example, a comparison of two types of resin coatings in which one was an opaque white and another an opaque black would not be as valid as if both materials had the same general color.

Calculating percentage gloss

5. (*a*) To avoid the complication of variability of photoelectric cell readings from surfaces of various original reflectivity and to minimize the effect of voltage variation on the light source, only the ratio of light intensity reflected at the two observation angles shall be used in the following formulas for calculating percentage gloss:

$$\text{Gloss, percent} = 100\left(\frac{I_1 - I_2}{I_1}\right)$$

where:

I_1 = photoelectric cell reading at the specular angle,
I_2 = photoelectric cell reading at the 60° angle (15° off specular), and
$\frac{I_1}{I_2}$ = measure of the sharpness of the peak of light distribution.

From this formula, a reading of zero at the off-specular angle gives 100 percent gloss, and equal readings at specular and off-specular angles give 0 percent gloss.

(Please turn to page 128

(*b*) In comparing abrasion characteristics of a series of materials which do not have the same original gloss, the initial gloss value of the unabraded surface shall be taken as 100 percent, and the progressive deterioration expressed in corresponding terms.

NOTE. Typical data are shown in the following table:

Abrasive, gm.	*Readings at: 45°, I_1*	*60°, I_2*	*Gloss,ᵃ percent*	*Percentage of original gloss*
0	93.5	2.0	97.9	100
200	60.0	4.0	93.3	95.4
400	43.5	5.0	88.5	90.4
800	33.0	6.0	81.8	83.5
1200	25.0	6.0	74.0	75.5
1600	19.0	6.0	68.4	70.0

a Gloss, percent $= 100\left(\frac{I_1 - I_2}{I_1}\right)$.

Plotting results

6. The percentage gloss of the abraded spots shall be plotted against the respective amounts of abrasive used, to obtain a characteristic curve. Since such curves for different materials are often found to change slope irregularly, they may cross each other, and the rating of a series of different materials using a given amount of abrasive may not be representative of their relation at other amounts of abrasive. One way to arrive at an over-all performance is to average the percentage original gloss at the various amounts of abrasive, which would represent the area included between the curve and the coordinate representing the amount of abrasive. (See Note, Section 4 (*a*).)

Lignin-enriched filler

(Continued from page 66)

Lignin extenders and their use in non-phenolic resins

No article on lignin extenders would be complete without mentioning two other factors—the use of other lignin extenders, and the use of extenders in resins other than phenolic. Marathon has facilities to produce 8 tons per day of a lignin resin (VDP). This material can be used to extend phenolic molding compositions. Compositions containing 13–15 percent phenolic, 13–15 percent lignin resin and 74–70 percent LEF have been made. These compositions will have approximately the same flow as the 23 percent phenolic-77 percent LEF composition discussed previously, but the flexural strength of the molded article will be 7000–8000, and it will have an impact of .25 to .3 ft.-lb. per in. of notch (Izod). Such compositions can be readily made. From experience, the use of the lignin resin as an extender for phenolic resins has been much more successful when used in applications other than molding compositions. For example, it can be used in the extension of resins and thermosetting adhesives, especially of the water-soluble type, since the lignin resin can be easily supplied in a water-soluble form.

The use of these two lignin products, the LEF and VDP, as extenders in urea-formaldehyde resins is under investigation. It is believed possible to make a urea-formaldehyde-lignin composition containing the same percentage of resin and LEF as was used in the phenolic-lignin molding composition and get approximately the same physical characteristics and

flow. The urea-formaldehyde compositions in general have slightly lower physical properties. For example, the impact will run .3 as compared to .4 ft.-lb. for the lignin-phenolic material. These compositions as yet do not have as good finishes as are obtained with the phenolic molding compositions. Thermoplastic compositions containing 10 percent cellulose acetate, 10 percent plasticizer, 10 percent thermoplastic resin, and 70 percent LEF have been compression molded under relatively low pressure. Injection tests on these compositions are now under way. The molded samples have flexural strengths from 7000 to 8000 lb. per sq. in. and impacts of .3 to .45 ft.-lb. These specimens, of course, were removed cold from the dies (below 100° C.).

While the use of lignin extenders in urea-formaldehyde and thermoplastic resins is undoubtedly interesting, they must be considered at the present only in the developmental stage. However, the lignin-phenolic material has been used in large quantities and an increase in production of phenol-formaldehyde molding compositions in the quantities given may be accomplished by the use of lignin now available

Grinding cast resins

(*Continued from page 77*) grinding plastics although a good supply of water-soluble lubricants or kerosene is necessary to keep the wheels free from the grindings. Many grades and widths of wheels can be used to produce the desired finish and size. Wide wheels are used in the centerless grinding of long cast rods to eliminate the center parting line which is always visible when rods are cast in split molds. Where extreme accuracy is essential in the production of small round parts, tolerances to within .0001 in. may be held by centerless grinding and thousands of parts put through in a few hours.

Many improvements have been made in sanding machines in recent years, thereby better fitting them to finishing operations in plastics. Longer endless belts of abrasive materials have been developed to speed up production of parts, and by the use of water the hazard of burning or discoloration has been greatly reduced. The speeds required in most sanding operations are about the same as those used in wood finishing.

Wood shapers are adaptable to plastics, although bronze is usually used in place of steel tools and few teeth are required. Slower speeds are also recommended. Many decorative lines such as radii, bevels, steps or irregular contours are quickly machined by making the tools to the desired shape.

Cutting and sawing

Thin abrasive wheels are exceptionally adaptable to the cutting-off requirements of plastic materials. Equipment has been developed to enable the operator to feed the wheels into the work at exactly duplicating angles, depths and widths, leaving smooth, easily polished cuts and very little waste. Various profile-shaped pieces, slabs or button blanks are cut by this method. The development of cutting-off machines embodying several cutting-off abrasive disks at one time greatly speeds up the production of disks from round bars, such as simultaneously cutting 40 poker chips $1^1/_2$ in. in diameter by $^1/_8$ in. thick at the rate of 10,000 per hour. Other shapes are handled equally as fast. The abrasive cutting disks are available in sizes from .020 to $^1/_{16}$ in. thickness and from 5 to 20 in. in diameter. The accepted spindle speeds vary from 3500 to 6000 r.p.m. and are entirely governed by the size of the disks used. A flood of water is necessary in all cutting-off operations by the abrasive disk method.

Jig, band and circular saws are employed in sawing cast resins. The jig saw is preferred where intricate designs are to be cut and scribed lines or a master pattern is to be closely followed. Several parts can be cut at one time by stacking and placing oiled paper between the layers for lubrication purposes. Circular saws having little set, 8 to 9 teeth per in. and turning at 1800 to 2500 ft. per min. with 8 in. to 9 in. diameters, are used for larger or medium-sized sections. Band saws with blades up to $^1/_2$ in. width, 14 to 15 teeth per in. and running at 1300 to 1400 ft. per min. are used very successfully for larger sections or for cutting slabs to intricate shapes and irregular designs. Because some of the cast materials cause the saw blades to dull quickly, they should be closely watched and changed before too much trouble is encountered. A dull saw may add hours to the finishing time of the parts.

Polishing and buffing

The dull appearance of machined or ground parts may be easily and quickly changed to a highly polished surface by the use of 12 in. to 14 in. diameter unstitched soft muslin disks mounted on a double spindle buffing lathe powered with a two-horsepower motor. Two disks or wheels are necessary, as the first one requires ashing. This is done by the frequent and generous application of a mixture of "00" pumice and water that has been mixed to a thick paste. The tool marks or undesirable scratches will soon disappear after a few brisk rubbings on this pumice treated wheel. The parts should then be thoroughly washed in water to insure the removal of all the ashing compound.

A high lustrous polish will be easily obtained by using the second wheel which has had an application of rouge or special polishing compound that is usually procurable in short bars or sticks. This is applied by holding it against the wheel revolving at the preferred working speed of from 1000 to 1500 r.p.m. An exceedingly hard and lustrous finish may be produced by using a clean soft wheel that is free from polishing compounds.

The use of tumbling barrels is much preferred to hand polishing because large quantities can be polished at one time. Hexagonal or octagonal hardwood barrels operating at 30 r.p.m. for from 5 to 12 hours loaded with three parts pegs, two parts articles, one cup of "FFF" pumice and one and one-half cups of flushing oil or paraffin oil will take the place of ashing in the hand polishing process. The final polishing is done in other barrels where various polishing compounds are added.

LAST CALL
DIRECTORY LISTINGS FOR 1943 PLASTICS CATALOG

If any of our readers has entered the plastics field in any way during the last year and wishes to be listed in our new 1943 Directory, or desires to have last year's listing changed, we urge him to request a listing blank. This must be returned by September 25. There is no cost or obligation involved by this listing, and we hope you will cooperate to make this new Catalog Directory as complete as possible.

Listings include: Plastics and raw materials, such as resins, fillers, lacquers, vulcanized fibre, plasticizers, scrap plastics, solvents, etc.; Machinery, equipment and supplies, such as fastening devices, machine tools, marking devices, presses, testing apparatus, etc.; Molders, laminators and fabricators and allied services, such as applied decoration services, consulting and testing laboratories, industrial designers, extrusion processors, model makers, etc.

Publications

(Continued from page 100)

★ SECTION I OF THE KOROSEAL HANDBOOK OF Technical Information is now available upon request from the B. F. Goodrich Co., Akron, Ohio. This 24-page booklet, fully illustrated with photographs, charts and graphs, treats the general subject of the nature and chemistry of this group of plasticized vinyl resins, its physical properties, plasticizers, stabilizers and pigments used in compounds, and mixing and processing procedures. It also discusses and pictures a variety of its uses. Of special value and interest are manufacturing flow diagram, specific viscosity vs. physical properties chart, effect of quantity of plasticizer, electrical effects of aging, difference in plasticizers and physical effects of various pigments, and the two tables—one on physical constants and the other on plasticizer comparison. Sections 2 and 3 of the Handbook, which are not yet available, will discuss Koroseal insulating and jacketing materials for the wire and cable industry, and laboratory test evaluating thermoplastic and thermosetting materials.

★ TAYLOR FIBRE CO., NORRISTOWN, PENNA., offers a new 56-page handbook on Vulcanized Fibre and Phenol Fibre. Covered in this book are laminated plastics for electrical insulation, for radio, for electronics, for aircraft (including the new laminated plastics construction of air-foil sections), for silent gears and for the railroad and automotive industries. There are many helpful tables and other data to guide designing and production engineers in the selection, fabrication and application of the material best suited to their particular purpose. The booklet is fully illustrated.

★ ACTUAL SHOP PHOTOGRAPHS SHOWING THE scope of application of Delta Manufacturing Co., machinery are included in a new booklet available from this Milwaukee, Wis., company. Adaptations of drill presses, grinders, cut-off machines, abrasive finishing machines, circular, scroll and band saws are all shown in connection with the armament program. Pictures of arsenals, aircraft plants, shipyards, foundries, training schools, ammunition factories and war production plants of many types showing special set-ups described as having been developed at low cost, are pictured.

★ THE COMPLETE LINE OF ERNST DRUM AND barrel carriers has been illustrated and described in a new folder just issued by the Ernst Carrier Sales Co., 1456 Jefferson Ave., Buffalo, N. Y.

★ METALLIC SOAPS IN THE PROTECTIVE-COATINGS industry are described in a section of "Protective and Decorative Coatings" by Francis J. Licata, chief chemist of the Metasap Chemical Co., subsidiary of National Oil Products Co., Harrison, N. J. Special chapters dealing with the manufacture, methods of testing and solubility of metallic soaps, together with their uses, are contained in the book, which is volume 2 in a series of four related volumes being published by John Wiley & Sons.

★ CATALOG NO. 16, DESCRIBING SOUTH BEND 16-IN. precision lathes, has just been issued by the manufacturer, South Bend Lathe Works, Dept. 5Z, South Bend, Indiana. This 8-page, file size catalog completely illustrates and describes both the tool-room and quick change gear lathes. Attachments, accessories and tools for use with these lathes are also listed.

★ A BRIEF HISTORY OF THE NAIL SERVES AS THE introduction to the Hassall Catalog No. 40 issued by John Hassall, Inc., Brooklyn, N. Y. The 48-page booklet contains a full description, complete with photographs and illustrations of the wide variety of cold forged specialties, nail heads, special nails, special rivets, threaded screws, fluting, knurling, etc., available from this company.

CLASSIFIED

WANTED: THERMOPLASTIC SCRAP or rejects in any form, including Acetate, Butyrate, Styrene, Acrylic and Vinyl Resin materials. Submit samples and details of quantities, grades and colors for our quotation—Reply Box 508, Modern Plastics.

WANTED: PLASTIC SCRAP OR REJECTS in any form, Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Custom grinding and magnetizing. Reply Box 318, Modern Plastics.

FOR SALE: 1—W. S. Hydro-Pneumatic Accumulator 2500 PSI, 8 gal., with IR m.d. compressor; 1—Hydro-Pneumatic Accumulator, 2000 PSI, 16½ gals., complete with tank, compressor and piping; 1—Southwark 1000 Ton Hydraulic Press, 24" dia. ram, complete with horizontal Hydraulic Pump and motor; 1—W. S. 15" x 18" Hydraulic Press, 9" dia. ram, 4" posts; 6—Semi-automatic Hydraulic Molding Presses, from 15" x 18" to 32" x 36" platen surface, rams 9" dia. to 20" dia. ram, all with hydraulic pullbacks and slotted heads for die attachments; 1—W. S. Hand Pump; 1—Set of Compounding Rolls 18" x 44"; Adamson 6" Tuber; 7—W. & P. Mixers; Dry Mixers, Pulverizers, Grinders, etc. Send for complete list. Reply Box 446, Modern Plastics.

WANTED: Hydraulic Presses, Preform Machine and Mixer, Stainless Steel or Nickel Kettles, Vacuum Pan. No Dealers. Reply Box 275, Modern Plastics.

WANTED: THERMOPLASTIC MATERIALS of all descriptions—Scrap and Virgin. Please furnish full particulars and send small representative samples. It will pay you to consult us regarding custom grinding, demagnetizing, cleaning and grading of your materials. All inquiries will receive prompt and careful attention. H. Muehlstein & Co., Inc., 122 East 42nd Street, New York, N. Y.

FOR SALE: 1—Southwark 150 ton reversed cylinder Hydraulic Press, 15" ram, 42" stroke. 350 Ton Hydraulic Lead Wire Extrusion Press with Pump. 400 Ton horizontal Hydraulic Extrusion Press. Hydraulic Scrap Baler, 80 Ton, 6½" Ram, 90" stroke, 5000 lbs. per sq. in. Three J. H. Day #30 Imperial Mixers, double Sigma Blades, two steam jacketed. 75 ft. link belt conveyor, 36" wide. Large stocks of Hydraulic presses, pumps and accumulators, preform machines, rotary cutters, mixers, grinders, pulverizers, tumbling barrels, gas boiler, etc. Send for bulletins #156 and #138, and L-17. We also buy your surplus machinery for cash. Reply Box 439, Modern Plastics.

CRESYLIC ACID for sale. Limited supply available under government allocations. Inquire William D. Neuberg Company, 420 Lexington Avenue, New York City. Telephone LE 2-3324.

FOR SALE: Watson-Stillman Transforming Press with Pushbacks and Ejectors. Reply Box 512, Modern Plastics.

WANTED: MOLDING SHOP FOREMAN. Man thoroughly experienced in compression molding practice. Must be mechanically inclined and well acquainted with thermosetting plastics. Supervisory ability essential. Send all pertinent details in first letter. Reply Box 612, Modern Plastics.

WE WANT TO BUY several 6 and 8 oz. injection molding machines or a small molding shop in its entirety. Reply Box 613, Modern Plastics.

WANTED: 4, 6, or 8 oz. Injection Molding Machine in good condition. Give full details. Reply to F. J. Kirk Molding Co., Clinton, Mass.

WANTED: Mold designer and estimator with practical experience compression molding. Plant located northern New Jersey. State qualifications, age, draft classification and salary expected. Reply Box 615, Modern Plastics.

SUCCESSFUL PLASTIC MANUFACTURER withdrawing from present company, seeks association with going concern to establish new plastic division or manufacture consumer and industrial items with available materials and equipment. Company with defense orders preferred. Reply Box 617, Modern Plastics.

PLASTIC MACHINERY WANTED: All types of Plastic Presses and Machinery relating to Compression, Injection and Extrusion Molding of Plastics. State size, age, type and price. Reply Box 618, Modern Plastics.

INTERESTED IN BUYING outright or an interest in a plastic molding plant with compression and injection molding machines or a compression plant only. Write full details to Seymour Mamberg, 17 John St., New York City or call Cortlandt 7-8067.

OLD ESTABLISHED FIRM financially strong with national sales organization and with 150,000 square feet of manufacturing warehousing and showroom space in Manhattan seeks new lines. Will buy business or finance and distribute manufacturer's lines sold to department, gift, jewelry, furniture, house furnishing stores. Mr. Alton, 1133 Broadway, New York City. ALg. 4-2644.

WANTED IMMEDIATELY purchase or rent, Extruders, National or Royle 2½" or larger. State age, condition and price. R. D. WERNER CO., INC., 380 SECOND AVE., NEW YORK, N. Y.

WANTED

Nationally known Midwest company rated AAA-1 opening plastics division requires experienced manager to set up and operate this division. Write to Box 614, Modern Plastics, stating complete education and experience, eligibility for military service and salary expected.

WANTED: Would like to purchase any quantities of plastic draughts, tumblers, telephone indexes, tobacco containers, children's teasets, chessmen, household items, and similar goods. M. I. Horn Import Company, 377 St. James Street West, Montreal, Canada.

WANTED
Tool and Die Engineer
and
Practical Plastic Man

Must be thoroughly experienced in tool and die design and construction, and in design and manufacture of molds for various synthetic and natural rubber goods. Excellent opportunity with established concern for qualified person. State years experience, firms worked for, age and salary expected. Must be United States citizen. Give full details in first letter. Will not consider persons presently employed in war production. Reply Box 619, Modern Plastics.

WANTED: For cash—injection molding machine 2 to 4 ozs. State condition and price. Reply Box 620, Modern Plastics.

PLASTIC TUBE Factory wanted to undertake manufacture of substitute for collapsible tin tubes on contractor or other basis. Write, United States Interrub Processes, 30 Rockefeller Plaza, New York City.

WANTED TO BUY used Injection Molding Machines, four, six or eight ounces. State type, condition of machine. Reply Box 621, Modern Plastics.

MAKE IT OF PLASTIC—sell 20 million. New invention for large territory. Sta. B—Box 1324—Cleveland, Ohio.

WANTED: Injection molding machines. Immediate cash for six, eight, ten or twelve ounce units. Reply Box 622, Modern Plastics.

WANTED: Complete injection molding plant. Require shop with at least two six ounce machines. 100% cash. Reply Box 623, Modern Plastics.

WANTED: 4 or 8 ounce injection moulding machine in first-class condition. State full particulars. Reply Box 624, Modern Plastics.

BUTTON MOLDS WANTED: Injection and/or compression molds for making self-shank buttons wanted. WILL PAY CASH FOR THESE MOLDS. Reply Box 625, Modern Plastics.

WANTED: Plastics engineer with experience in design and construction of machinery, especially injection molding machines. Should be familiar with injection molding companies and current practice. Apply by letter giving full details of experience, age and salary desired. Reply Box 616, Modern Plastics.

Index to Advertisements

Modern Plastics

BRESKIN PUBLISHING CORPORATION
122 E. 42nd St. NEW YORK, N. Y.

PLASTICS THAT PUT

"FIGHTING MUSCLES"

IN WOOD!

BAKELITE resins fortify wood to win the battle against heat, cold, sea water, and mold growth!

Trees, too, are being called by "selective service"—harvested at maturity from our nation's vast replaceable resources. And—thanks to plastics research—wood can now gain strength, and resistance to the elements, never before attainable!

With the advent of resin bonding and impregnating, wood need no longer be limited in its use as "hardwood" or "softwood"—need no longer be looked upon as strong only with the grain. Through plastics research, hard woods may now be combined with softwoods, rare veneers bonded to less expensive core stocks, multiple plies crisscrossed for two-way strength. Thus, wood products gain the uniformity they have always lacked.

Bakelite urea and phenolic resin glues make possible a superior kind of plywood. It's strong. It resists impact. It *keeps* its strength in spite of temperature changes and moisture—even sea water! Mold, which would feed and grow on natural glues, does not affect it.

Too, Bakelite saturating resins make possible stabilized and densified woods that can form panel sections with a strength-weight ratio higher than that of most metals... *molded* woods that take varied shapes and forms.

Combined with synthetic resins, wood can now serve better than ever before... in aircraft wings and fuselages, truck and trailer bodies, prefabricated houses, ship bulkheads and superstructures. If you can use these fortified woods in essential production, the full co-operation of Bakelite Plastics Headquarters is at your service.

Bakelite Corporation, 30 East 42nd Street, New York, N. Y.

Unit of Union Carbide and Carbon Corporation

UCC

BAKELITE

The word "Bakelite" and the identifying products Symbol are registered trade-marks of Bakelite Corporation

PLASTICS HEADQUARTERS

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS